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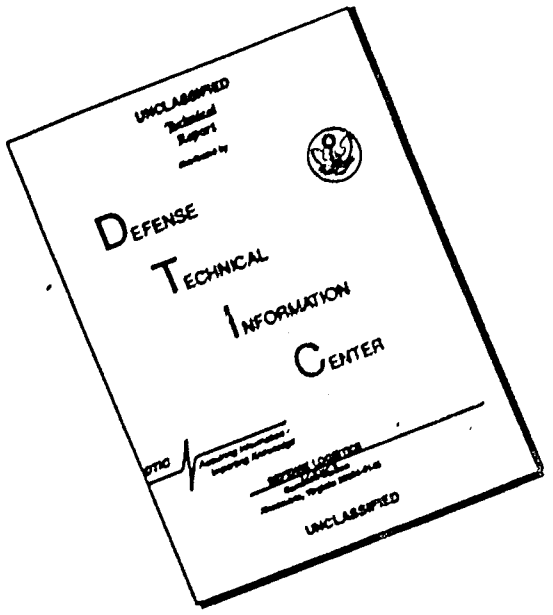

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DEPARTMENT OF THE ARMY
OFFICE OF THE ADJUTANT GENERAL
WASHINGTON, D.C. 20310

IN REPLY REFER TO
AGAM-P (M) (23 Jul 68) FOR OT RD 682187 8 August 1968

SUBJECT: Operational Report - Lessons Learned, Headquarters, 93d Engineer Battalion (Const), Period Ending 30 April 1968

SEE DISTRIBUTION

FOR OT RD WASH D.C. 20310

1. Subject report is forwarded for review and evaluation in accordance with paragraph 5b, AR 525-15. Evaluations and corrective actions should be reported to ACSFOR OT RD, Operational Reports Branch, within 90 days of receipt of covering letter.

2. Information contained in this report is provided to insure appropriate benefits in the future from lessons learned during current operations and may be adapted for use in developing training material.

BY ORDER OF THE SECRETARY OF THE ARMY:

Kenneth G. Wickham

KENNETH G. WICKHAM
Major General, USA
The Adjutant General

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as

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DEPARTMENT OF THE ARMY
Headquarters, 93d Engineer Battalion (Const)
APO San Francisco 96530

EGFB-OP 13 May 1968

Subject: Operational Report - Lessons Learned
for Quarterly Period Ending 30 April 1968

Commanding Officer, 34th Engr. Gp. (Const), APO San Francisco 96291
Commanding General, USARV, ATTN: AVHGC-DST, APO San Francisco 96307
CINCUSAPAC, ATTN: GPOP-DT, APO San Francisco 96558

Section 1: SIGNIFICANT ORGANIZATION OR UNIT ACTIVITIES

1. Command:

a. The mission of the battalion is as follows:

(1) Construction and support of a base camp, Bear Cat, defined in five construction directives.

(2) Construction of an all-weather, C-130 capable, operational, self-supporting airfield facility and cantonment, defined in five directives.

(3) Construction of an approximately 706, 700 SY MER heliport to include 170 rotary wing aircraft revetments (CD 34-68-5MER-93).

(4) Construction and support of a base camp, Dong Tam, defined in five construction directives.

b. Command and Staff: The command of the battalion remained with LTC James Dorman, CE, 066844, during the period. Some command and staff positions were changed as a result of directed personnel infusion and the desire to give personnel command/staff time.

(1) S-1: 1LT Wayne A. Theiss, CE, 05422577
Vice: 1LT Michael E. Neff, CE, 05538348

(2) Commo Off. CPT Francis M. Morasco, CE, 0F100965
Vice: 1LT Joseph L. Soczek Jr., CE, 05535907

(3) Engineer Equip. Maint. Off: CPT Francis M. Morasco, CE, 0F100965
Vice: CPT William A. Miller, CE, 0F102562

(4) CO HQ Co: 1LT Joseph L. Soczek Jr. CE, 05535907
Vice: CPT Justice W. Edge, CE, 05418422

(5) Battalion Surgeon: CPT Willis M. Stevens, 05426209
Vice: CPT Carl D. Walker, 05541429

(6) Battalion Chaplin: CPT Malcom J. Brummitt, 02326135
Vice: CPT Robert E. Barker, 05701592

c. The battalion remains assigned to the 34th Engr. Group (Const), 20th Engineer Brigade, and the USARV.

d. The U. S. Army Engineer Detachment (Tree Crusher) (Provisional) remained attached until the last day of the reporting period. As of the last day of the reporting period, the tree crushers were being disassembled and packaged for shipment back to the United States. C Company, 69th Engineer Battalion was attached to this unit for operational control on 1 March 1968.

e. Stationing: One construction company, part of the battalion support company, and part of the headquarters remained in the WABTOC base camp adjacent to the Long Thanh North Airfield and two kilometers southwest of Camp Martin Cox. The battalion cantonment is known locally as Camp Castle (YS1498). Two construction companies, a maintenance section from the support company, and a headquarters section were stationed at a base camp location (XS4744) of the 9th Infantry Division (Dong Tam). The tree crusher detachment, while based at Camp Castle, operated throughout the 9th Infantry Division AO.

2. Personnel, Administration, Morale, and Discipline:

a. Personnel:

(1) At the end of the reporting period, the battalion personnel strength was as follows:

	OFF	WO	EM	TOTAL
Authorized	31	7	867	905
Assigned	33	6	797	836

(2) The following personnel turnover has occurred during this period.

	OFF	WO	EM	TOTAL
Transfer Out	2	2	202	206
Transfer In	5	2	257	264

(3) The personnel adjustments made during this period were major for EM and minor for officers. The infusion program and rotation of personnel accounted for most of the adjustments.

(4) The battalion currently employs 185 permanent and 62 daily hire local Nationals. Skills have been developed through training. Necessary skill has not been available to fill all the requirements. The construction effort has been greatly benefited because of the employment of Vietnamese personnel.

b. Administration:

(1) Reports: During the period, 636 battalion level reoccurring reports and 129 one time reports were submitted.

(2) Availability and timeliness on receipt of new in country publications from USARV has improved during the period. However, requisitions continue unfilled for those USARV publications published prior to the last reporting period.

c. Morale: Morale in the unit is high. The present time off policy allows one half day off per week if possible. Living conditions continue to improve. Each company and staff section improves their living and operational areas by self help. Feature films are shown each week. NCO/EM clubs and special services facilities are also available both at Bear Cat and Dong Tam. USO shows and excellent rations contribute substantially to morale.

d. Discipline: Disciplinary actions taken during the period were as follows.

	Art 15	Summary Court	Special Court
February	14	2	4
March	16	0	0
April	17	0	2

3. Intelligence and Counterintelligence

a. Unit Intelligence:

(1) This unit has no assigned intelligence mission. The battalion intelligence NCO does, however, provide liaison with the 9th Infantry Division G-2 and a nearby Special Forces Camp to obtain information relative to base camp and job security. Occasionally visits are also made to the U.S. Advisory Team in Long Thanh. Security information for the Dong Tam base camp is obtained each day in the daily intelligence briefing.

(2) The unit intelligence officer has granted 7 confidential security clearances during the reporting period.

b. Long Thanh North Security: The responsibility for the Long Thanh North Airfield complex security has remained with the 210th Avn. Bn. (Cbt). At the present time, this unit is required to provide 89 men per night for guard duty. The number of guards increases during alerts. The following is a summary of the manhours expended for security during this period:

	Feb. 68	Mar. 68	Apr. 68
Base Camp Security	30,889	20,512	21,600
Job site security and compensatory time (Lost to construction effort)	2,996	4,505	4,080

The present compensatory time policy allows the battalion OD, battalion SOG, and personnel selected by each sub sector commander (Company Commanders) up to 4 hrs off the day following their guard duty. Usually each company will grant the third relief guards two hours off and the company charge of quarters and the company SOG four hours off.

c. Dong Tam Security: The overall responsibility for security at Dong Tam belongs to the 9th Infantry Division. However, this unit does have a sector of responsibility within the Dong Tam base camp. Thirty one (31) EM are required for guard duty each night. The following is a summary of the manhours expended for security during the period:

	Feb. 68	Mar. 68	Apr. 68
Base Camp Security	1,144	5,184	7,560
Job site security and compensatory time (Lost to construction effort)	3,546	4,008	5,578

The compensatory time policy at Dong Tam allows the battalion OD and the battalion SOG four hours off the day following their guard duty. The bunker guards are allowed two hours off the day after their guard duty.

4. Plans, Operations, and Training:

a. Battalion Operations: During the reporting period, the battalion has been primarily committed to base camp and airfield construction. Combat support has primarily taken the role of equipment support to engineer combat battalions both within the group and outside the group and the employment of the tactical tree crusher.

b. Plans: Standard plans were used as often as possible during the reporting period. However, in many cases standard plans could not be used because standard buildings were not built. In the case of non-standard buildings, the desires of the customer were met as long as the final product did not exceed the authorized square footage or authorized cost.

The following is a list of plans completed during the reporting period:

LIST OF DRAWINGS

93d Engr. Bn. Dwg. No.	Title
210-H	Bear Cat POL System
211-I	78 foot Grease Rack
212-1	Grease Trap
213-K	Bear Cat Fire Station
214-K	Chapel Pew
215-K	2 Story BOQ 20' x 100'
216-K	32' x 32' bunker
217-K	20' x 96' Tech Supply
218-K	20' x 96' Opns. Bldg.
219-K	Mess Hall Gas Line System
220-K	Rotor Blade Balance Bldg.
221-K	Aircraft Ammo Shed
222-K	20' x 40' Opns. Bldg.
223-K	210th Avn. Bn. NCO Club

c.

C. COMPANY OPERATIONS:

(1) Company A, in providing 24 hours maintenance support, completed 153 battalion maintenance jobs, 232 direct support jobs, and 131 allied trades jobs. A total of 10,093 manhours and 3,571 equipment hours was expended in completing the jobs. Company A was also responsible for prime and tack coat operations for the paving of the Long Thanh North Airfield. 14,479 gallons of RC800 were used in preparing 75,300 square yards of area for paving. The equipment platoon provided technical assistance and equipment support for the placement of 67,192 gallons of dust pallatives at Long Thanh North. The A Company equipment section at Dong Tam placed 47,048 gallons of dust pallatives at Dong Tam. Company A also expended 11,847 manhours in support of combat operations by the tactical tree crusher.

(2) The main body of Company B moved to the 9th Infantry base camp at Dong Tam on 14 February 1968. After arriving in Dong Tam, Company B completed constructing their company area to include seven mortar bunkers which are capable of housing 30 troops each. Besides working in their company area, Company B began work on the 9th Infantry Division MER heliport. The work consisted of a rough and final grading of the northern most part of Dong Tam, stabilizing roads with cement, stabilizing helicopter parking pads with cement, covering the helicopter pads with T-17 membrane and M8A1 matting, and constructing 170 each aircraft revetments

Due to the ever frequent mortar attacks, it was decided that the MUST hospital units at Dong Tam would receive a protective shell. Company B received the job. The protective shells were made of 18' high revetments four feet wide at the bottom and two feet wide at the top placed around the units with a roof made of 12" x 14" beams covered with 2' of earth over top of the units. The project is presently 60% complete. Company B also supplied equipment for combat support as well as equipment and personnel for the off-loading of barges at Dong Tam.

The following is a summary of B Company's construction effort during the reporting period:

a. Total manhours expended on projects:	72,500
b. Total equipment hours expended:	23,983
c. Cubic yards of fill hauled:	192,120
d. Cubic yards of concrete placed:	97
e. Square feet of revetment construction:	71,800
f. Square feet of soil stabilized area:	333,600
g. Square feet of T-17 membrane placed:	70,460
h. Square feet of M8A1 matting laid:	26,804
i. Square feet of buildings constructed:	8,000
j. Square feet of bunkers constructed:	1,608
k. Square feet of area peneprimed:	106,584

(3) Company C moved to Dong Tam on 7 March 1968. Before leaving, C Company completed a 44' high control tower in Bear Cat and a 20' x 96' (Pascoe building) Brigade Headquarters building also in Bear Cat. The earthmoving platoon was involved in laying base course on the LTN airfield. The platoon completed laying base course on 520,000 square feet of parking area space.

Company C was also involved in LOC improvement when it received word to move. Before the move however, C Company completed a 60' bridge with concrete abutments, steel stringers, and a wooden deck. Work was begun on a second site which required three 72" culverts 70' long with concrete footers and headwalls. The culverts could not be finished because of the move to Dong Tam. Construction at both sites was greatly hampered by the TET offensive.

After arriving in Dong Tam, C Company completed their company area and then began construction on engineer projects. The earthmoving platoon became involved in building an ammunition supply point. The project required fourteen 50' x 60' stabilized pads with a berm around each pad and a stabilized access road to each pad. So far the project is 90% complete.

Company C also became involved in placing mess hall slabs and repairing the Dong Tam airfield. The airfield repair job required removal of 4,723 SY of T-17 membrane and M8A1 matting, stabilizing the base material with cement, laying new T-17 membrane and new M8A1 matting, and painting the runway with a non-skid compound. The job was completed in a record time of 10 days. Company C also had the responsibility of off-loading all engineer materials that arrived by barge and off-loading and stockpiling rock for QL 4 repair work. In addition, C Company operated a batch plant at both Bear Cat and Dong Tam and provided technical supervision for self help construction at Dong Tam.

The following is a summary of C Company's construction effort for the reporting period.

a. Total manhours expended on projects:	67,847
b. Total equipment hours expended:	33,600
c. Cubic yards of concrete placed:	573
d. Cubic yards of fill hauled:	115,000
e. Cubic yards of base course spread:	9,630
f. Square feet of buildings constructed:	4,860
g. Tons of plant mix asphalt hauled:	7,425
h. Square yards of stabilized road:	9,333

(4) D Company assumed responsibility for both vertical and horizontal construction at the Long Thanh North Airfield during this period. The effort was distributed so that one construction platoon worked in support of facilities in the north ramp area, the other construction platoon worked on facilities in the south ramp area, and the earthmoving platoon worked on the airfield itself.

D Company's first construction platoon completed a 2700 square foot dog kennel, 16,000 square feet of closed storage space, a fifteen

foot high wash rack water tower with a 250 BBL bolted steel tank on top, and a 20' x 96' avionics bldg. Projects started but not completed during the period included two 175' x 190' aircraft hangars and a 40' x 120' air passenger terminal.

The 2nd construction platoon had the primary mission to complete all the concrete slabs for which building designs were available before the monsoon season began. Twenty seven (27) headwalls were completed during the period as were 22,920 square feet of building slabs. Construction was completed on a 40' x 130' fire and crash station, a 40' x 100' VIP Air Terminal, and a 30' x 64' dispensary.

D Company's earthmoving platoon assumed the responsibility of completing the earthwork for the airfield. Working a 24 hour day enabled the platoon to form the massive drainage areas at night and work on laterite grade and base course during the day. All airfield areas were brought to laterite grade and the base course was completed on the west warm-up pad and a 2500' west parallel taxiway. Base course is now being placed on the south ramp, east warm-up pad, and east parallel taxiway.

The following is a summary of D Company's construction effort during the period:

a.	Total manhours expended on projects:	68,627
b.	Total equipment hours expended:	28,777
c.	Cubic yards of concrete placed:	2,350
d.	Cubic yards of base course spread:	15,800
e.	Square feet of buildings constructed:	35,820
f.	Cubic yards of laterite hauled:	68,504
g.	Cubic yards of spoil material removed:	50,000

d. Base Development Operations:

(1) The present base development office at Camp Castle consits on one NCO and 1 EM. An officer from S-3 section has been appointed to supervise and coordinate activities both at Bear Cat and Long Thanh North. Construction has been hampered due to the lack of such materials as plywood, masonite, convenience outlets, and weatherheads.

(2) Bear Cat base develcpment construction was temporarily stopped because of a report by the USARV Ad Hoc Committee. However, a revised directive has been received and construction has continued on the facilities that still have authorized square footage left to be built.

(3) On 1 March 1968, this unit assumed responsibility for the Dong Tam base development program. The base development office at Dong Tam consists of 1 EM with an officer from S-3 supervising and coordinating activities. C Company has also been asked to supply technical supervision for self help construction. Construction has been hampered because of the lack of construction materials, particularly plywood.

(4) With the help of engineer technical supervision, units have completed the following facilities in Bear Cat, Long Thanh North, and Dong Tam during the reporting period.

BEAR CAT

DESCRIPTION	FAC CODE	AUTH SF	SF CONSTRUCTED THIS PERIOD	SF CONSTRUCTED TO DATE
Mtr Rep Shop	214.10	102,822	4,840	26,430
EM Housing	722.10	1,077,720	65,000	537,388
BOQ	724.10	135,850	13,200	86,496
Ord/Supply	610.16	111,360	0	68,608
Latrine	723.20	823 holes	0	823 holes
Urinals	723.20	166 tubes	0	166 tubes
Showers	723.20	884 heads	22 heads	901 heads
Chapel/Theater	740.77	33,262	2,280	4,560
GP Warehouse	442.20	32,640	0	31,040
Bg Hq	610.17	5,760	1,940	4,640
Bn Hq	610.14	24,480	0	27,840
Despensary	520.10	5,600	0	5,600
Div Chapel	740.16	3 200	0	2,280
Grease Rack	214.11	106 ea	0	11 ea
Library	740.40	3,326	0	4,000
EM Club	740 68	51,376	0	13,170
NCO Club	740.47	17,864	0	4,750
Post Office	790.59	8,315	0	5,750
Mess	723.10	232,834	0	230,084
Officers Club	740.48	12,350	0	2,600
Exchg Warehouse	740.55	14,100	0	9,900
Open Storage	451.10	8,315SY	0	584 SY

LONG THANH NORTH

EM Housing	722.10	59,780	1,920	46,080
BOQ	724.10	21,000	0	18,480
Ord/Supply	610.16	5,000	0	5,000
EM Mess	723.10	9,600	0	7,600
Bn Hq	610.40	1,140	0	1,140
Bn Storage	723.35	2,000	0	1,920
Hangers	211.10	93,850	0	30,300
Wash Racks	116.10	20,000	0	5,000
Opns Bldg	141.12	6,020	0	1,920
Avionics	217.40	3,840	0	960
Tmpy Opns Bldg	218.90	960	0	960
Tech Supply	442.10	27,600	0	9,220

DONG TAM

DESCRIPTION	FAC CODE	AUTH SF	SF CONSTRUCTED THIS PERIOD	SF CONSTRUCTED TO DATE
Mtr Rpr Shop	214.10	15,574	0	0
Mtr Rpr Shop	214.20	12,000	0	0
Grease Rack	214.11	16 ea	0	0
Wash Rack	214.13	24 ea	0	0
GP Warehouse	442.20	8,000	0	9,425
Open Storage	452.10	33,750 SY	0	3,000 SY
Dispensary	520.10	5,000	0	4,240
Dental Clinic	540.10	3,000	0	2,000
Hq Co/Supply	610.16	32,000	0	15,640
Bn Hq	610.17	3,000	0	10,720
Bn Hq	610.14	6,000	0	5,040
Mess Facility	723.10	105,000	5,760	100,460
NCO Club	740.47	8,400	0	3,000
Officers Club	740.48	3,000	0	0
PX & Warehouse	740.53	11,000	0	12,000
EM Club	740.68	28,800	0	0
Post Office	740.59	37,050	0	2,800
Water Storage	Tk841.20	375 TG	0	0

e. Tree Crusher Detachment:

(1) The tree crusher continued to clear areas in the 9th Infantry Division AO during the period. Nine hundred and fifty acres were cleared during the period making a total of 2,240 acres cleared by the tree crusher since being assigned to the 93d Engineer Battalion. Considerable maintenance problems were encountered during the period and were commented on in this unit's final evaluation. A copy of the final evaluation is enclosed (See Annex A).

(2) On 23 April 1968, this unit received orders to prepare the tree crushers for movement back to the United States.

f. Training:

(1) OJT/MOS training has, as in the past, been continuous and daily.

(2) Religious training in the form of services and character guidance continued on a regular basis for all personnel.

(3) The annual gas chamber exercise was held on 17 March 1968. The exercise was proceeded by a one hour class on the proper fitting of the protective mask. The exercise consisted of entering the chamber masked, remaining a short time to insure the mask worked, and removing the mask while in the chamber to show each person the true value of the protective mask.

(4) The battalion continued emphasis on a daily job site safety talk on safety problems peculiar to that job. Also, safety discussions with drivers during the scheduled maintenance periods were continued.

(5) Incoming personnel are still receiving a one day orientation on such selected subjects as mines and booby traps, Viet Cong tactics and techniques, security, sentry duty, POW and detainee handling, convoy procedures, and immediate action drills.

(6) The formal program for training NCOs was limited during the reporting period because of the move of two companies to Dong Tam. However, any NCO or prospective NCO desiring to obtain the training is sent to a one week course conducted by the 9th Infantry Division's Old Reliable Academy whenever possible.

(7) The current battalion training includes a mandatory training program covering the Geneva Convention, military justice, (OFF and WO), psychological warfare, safety, Code of Conduct, civil affairs, SAEDA, safeguarding defense information, counterinsurgency, counterguerilla training, survival, escape and evasion, armed forces censorship, CBR training, and gas chamber exercise, clandestine surveillance and listening devices, field sanitation, material readiness, supply economy, Vietnamese Relations, sentry duty, preventing heat injuries, map reading, adjustment of artillery fire (Off and WO), and M-16 training. M-16 training is given weekly as is Command Information.

5. Logistics:

a. S-4 Operations: As a result of the relocation of B and C Companies to Dong Tam, the placing of C Company 69th Engineer Bn. (Const) under this unit's operational control, and the assumption of the base development responsibility in Dong Tam, it was necessary to establish a split S-4 operational system. In order to carry the additional load, a LT was assigned as the S-4 in Dong Tam and 8 EM were moved to Dong Tam to handle class IV supplies. All materials for Dong Tam are requistioned by the S-4 at Camp Castle from the PA&E Engineer Construction Materials Yard in Vung Tau. The use of the depot in Vung Tau has greatly reduced supply problems inherent to Dong Tam.

b. Material Shortages: The major construction material which remained in short supply throughout the entire period was plywood of all sizes. Plywood shortages have made it necessary to redesign several projects. Electrical materials such as wire, fans, and flourescent light fixtures also continued to be very cyclic in their supply.

c. CM-SH: The CM-SH method of obtaining critically short materials is not proving to be as effective as orginally anticipated. The long amount of time required to process the request and the difficulty in obtaining the status of requisitions are two of the main deterrents. It is felt that the CM-SH method should be used only for unusual construction materials.

d. Movement of Materials: The movement of materials has been the largest problem faced by the S-4 section during the reporting period. The limited barge and off-loading facilities as well as the low priority of construction materials has seriously hampered the construction effort in Dong Tam. Materials are often available for as long as three weeks before they can be moved. The movement of two thirds of the

battalion's lowbeds has severely hampered the movement of materials from depot to Camp Castle. The necessity for moving materials to Dong Tam on float bridge trucks has also reduced the available means for moving materials to Camp Castle.

6. Force Development: C Company, 69th Engineer Bn. (Const) was attached to this unit for operational control on 1 March 1968. C 69th is stationed at Dong Tam and has been actively engaged in base construction since September 1967.

7. Command Management:

a. The battalion's command management inspections continued to provide not only a means of analyzing and comparing the areas of mess, supply, operations, maintenance operation, construction management and administration, savings programs, and reenlistment, but also provided an incentive for company competition for best company of the month.

b. Competition for engineer soldier, mechanic, operator, and Specialist Five of the month provided an incentive for MOS proficiency and knowledge of general military subjects.

c. In addition to the scheduled monthly inspections, the Battalion Commander and staff sections choose selected areas for spot checks to insure the efficient functioning of the organization.

8. Inspector General:

a. The AGI of the 93d Engineer Battalion (Const) was held on 15 April 1968.

b. The battalion received a satisfactory rating on the inspection. All discrepanies noted by the inspector were either corrected at the time they were noted or were corrected as soon as possible after the inspection.

9. Information: During the reporting period, a total of twelve (12) public information stories and a total of four hundred twenty six home town news releases were turned into higher headquarters. The battalion continued the policy of flying a different state flag each day. Personnel from the state whose flag was being flown had their pictures taken with the flag and also filled out a hometown news release.

10. Civic Action:

a. Civic action projects during the period included hauling laterite to prepare a site for a school in Long Thanh, doing some earthwork for an orphanage near Long Thanh, and giving 11,600 BF of 1" x 6" lumber and 4,960 BF of 2" x 4" lumber to the Vietnamese at Dong Tam.

b. Medical civic action projects include two hundred dollars worth of medical supplies given to the Cassell Clinic in Long Thanh and frequent MEDCAP visits.

11. Maintenance:

a. The battalion continued to have a low deadline rate. However, it has become increasingly difficult to maintain a low deadline because of the conditions encountered at Dong Tam and because of the non-availability of repair parts.

b. It has still been necessary to spend considerable maintenance personnel time in providing parts. Repair parts needed at Dong Tam are procured through the support company at Camp Castle. Even though command emphasis is still placed on utilization of the parts request system, this unit has still had to obtain parts from the cannibalization point and friends in order to keep our equipment running. An added problem is movement of the parts from Camp Castle to Dong Tam.

Section 2 (Part I): Observations (Lessons Learned)

1. Personnel: None

2. Operations:

a. Item: Airfield Markings

Discussion: In painting airfield markings properly on asphaltic cement or concrete runways, care must be taken to insure that painted lines or other markings are sharply defined and in the proper position on the runway. Construction Engineer units do not have authorization for sophisticated painting equipment for this type of work thus requiring a field expedient to produce a satisfactory end product.

Observation: A simple field expedient was developed which enables rapid and accurate placement of runway markings. After laying in centerlines on runways and taxiways with a transit and a string line, prefabricated templates made of 5/8" plywood were used to mark the areas to be painted. An inside corner template, outside corner template, and two straight edges were all that was required to paint a centerline strip. The templates were placed on the runway surface and the area to be painted was either sprayed with a hand spraygun or painted with a brush and roller. The result was a sharply defined runway marking free of distortion and overspray.

b. Item: Cement Chutes for Soil Stabilization

Discussion: Soil and cement stabilization requires a considerable amount of manhours and is a back breaking job. The most time consuming job is placing bags of cement on the ground, breaking them open, emptying the bags, and then removing the bags.

Observation: The time required to place the cement on the ground was greatly reduced by the use of two metal chutes mounted on the back of a ten ton crane attachments trailer. The cement was first placed on the trailer. The trailer was moved into position and the cement bags were placed on the ground by sliding them down the chute. Approximately two thirds of the distance down the chutes, knife edges were placed so that the bags of cement were cut as they passed down the chute. Once on the ground, all that was left to do was to shake the cement out of the bag and remove the bag.

c. Item: Tie Wire and Splice

Discussion: When constructing reveted walls for bunkers, wire was used to tie the two walls together. Twisting the wire at a splice weakened the wire and often caused it to break.

Observation: A double loop splice was used to connect two wires instead of twisting them together. The double loop splice did not weaken the wire thus making the wire capable of holding more weight.

Common Splice

Loop Splice

d. Item: Rain Protection of Sandbag Bunkers.

Discussion: Sandbag fortifications are more effective against shrapnel when the sand in the sandbags is dry. According to FM 5-34 and from experience, the protection afforded by a sandbagged fortification is reduced by as much as 50% when the sand is wet.

Observation: Whenever possible, peneprime or other water shedding substances should be applied to the outer bags on a sandbagged bunker or fortification.

e. Item: Building Walls for Wood Hutments.

Discussion: Several methods have been used in the construction of walls for tropical wood hutments. One such method is to prefab the panels, carry them to the job site, erect them, and place the screening and siding. Another method is to build the stud wall in place, stand up each section, and then place the screening and siding.

Observation: It has been determined that the most efficient way to build walls for tropical wood hutments is to build them in place. Large sections should be built and then put in place to form a wall. The screening and siding can be completed once the sections are put in place.

f. Item: Reveting of Bunkers

Discussion: The reveting of bunkers with sandbags always presents two problems. First, sandbags are often hard to obtain and secondly, the filling and placing of the sandbags is time consuming.

Observation: The best solution to the problem is to construct a reveted wall. A reveted wall can be built, wired, and filled in approximately half the time it takes to build the wall out of sandbags. The reveted wall will last from two to five years whereas the sandbag wall will last only one year. The cost of a reveted wall is also considerably less than a sandbagged wall.

g. Item: Stretching and Alignment of M8A1 Matting.

Discussion: In TM 5-366, it is suggested that once a 60' or 70' section of M8A1 matting is placed, it should be stretched to remove the slack from the joints. It was found that a maximum of 50' of matting is all that should be laid prior to stretching. A 50' section was also easier to align. The matting was stretched and aligned by the use of five ton dump truck winches.

Observation: In the stretching and alignment operation for M8A1 matting, each fifty foot section should be stretched and aligned. During the operation, a guide should be placed on each side of the matting to signal the truck driver to tighten or loosen the cable.

h. Item: Correction of Improper Spacing of M8A1 Locking Devices.

Discussion: Due to the different manufactures of M8A1 matting and the slight manufacturing deficiencies, not all matting will fit properly. The most common deficiency is improper spacing of the male bayonet lock connectors. To correct the difficiency, about 1/8" to 1/4" of the male bayonet lock connector can be cut away allowing the panel to slide sideways the required distance and properly interlock.

Observation: The method of cutting the male bayonet lock connector so that the panels will fit together has proven to be very effective. Cutting the connector does not materially affect the shear and moment strength of the devices and provides positive locks.

i. Item: Interlocking the Sliding End Connectors on M8A1 Matting.

Discussion: While interlocking tho sliding end connectors pins on M8A1 matting, it was discovered that it was very time consuming and almost impossible to slide the connector in place using a sledge hammer or pick when the matting was on a transverse slope of 2% or more.

Observation: A new method had to be developed to interlock the sliding connectors on M8A1 matting when the matting was placed on a transverse slope of 2% or more. A breaker bit for a pneumatic jack hammer was cut so that it had a 3/4" x 3/4" head. The bit was placed in the jack hammer and used to force the sliding connector in place. By use of the jack hammer, a panel with four sliding connectors could be slid into the locked position in an average time of tem (10) seconds. For slopes of less than 2% the conventional method for locking the matting should be used (hammer or pick).

j. Item: Site Preparation for Placing Concrete on a Sand Base.

Discussion: While placing concrete on a hot and dry sand base, it was found that the water in the concrete was very rapidly absorbed by the sand. The loss of water caused the concrete to be difficult to finish and also gave an inferior product.

Observation: In placing concrete on a sand base, the sand should be wetted down the night before the concrete is placed and also just before the concrete is placed. The water in the concrete will not be absorbed by the sand thus allowing proper finishing of the concrete.

k. Cement Stabilization

Discussion: When stabilizing an area in which the grade is critical, it is first necessary to bring the area to final grade. The cement can than be placed and the discing process begun. It is important to establish a definite discing pattern so that the material is not shifted thus ruining the grade. It is also very desirable to spray the maximum amount of water in the shortest possible time.

Observation: During the actual cement stabilization process, the material to be stabilized must be treated as a base course material as far as application of water, grading, and compaction are concerned. Once hydration begins, all equipment must be kept off of the area to prevent cracking of the stabilized soil.

l. Item: Vehicle Dispersion During Mortar Attacks.

Discussion: The most sensitive areas of a vehicle when mortar rounds begin falling are the tires and radiators. A tremendous amount of damage can be done to several vehicles by one mortar round if the vehicles are too close together. Building revetments will help protect vehicles. However, revetments construction is time consuming and not always worth the effort.

Observation: To hold vehicle damage at a minimum without revetments, the vehicles should be no less than 150' apart. A random pattern of parking will also decrease the chances of mortar rounds being walked up and down a row. Should Vietnamese personnel be working in or around a vehicle parking area, the vehicles should be placed in their final location after the Vietnamese have departed for the day.

m. Item: Prevention of Cracking in Concrete Slabs.

Discussion: When placing concrete in extremely hot weather, cracking becomes a continous problem. The cracking of the concrete makes it very difficult to obtain a good finish and also produces an inferior product.

Observation: Initial cracking can be prevented by putting a rough finish on the slab with a wooden trowel. The roughness tends to prevent rapid evaporation of water prior to putting the final steel trowel finish on the slab. Once the finish is completed, the entire slab must be kept wet for at least two days.

n. Item: Straightening Steel Members of Pasco Bldgs.

Discussion: In straightening bent steel members of Pasco Bldgs., it was found that heating the members caused them to lose some of their strength.

Observation: The steel members can be straightened without heating by placing the member on wooden blocks and then lowering a 290 bobtail blade on the member.

o. Item: Proportioning and Laying Base Course Material.

Discussion: Due to a lack of natural base course material, it became necessary to mix laterite with 1½" minus rock in the proportion of 2 parts laterite to one part 1½" minus rock.

Observation: An effective method of mixing and proportioning the base course material was found by using a front loader and a 290 scraper. The front loader, working from two stockpiles, placed the

two materials in the specified proportion in the scraper. Additional mixing was done by a grader after the material was laid on the ground.

p. Item: Use of a D-2 Dozer.

Discussion: While building a protective shell around the MUST hospital units in Dong Tam, it was decided that revetments would be built around the units instead of a sandbagged wall. A problem developed, however, when it came time to fill the revetments.

Observation: The filling problem was solved by placing the fill material on top of the protective shell by a crane with a clamshell attachment. The fill was then pushed into the revetments with a D-2 dozer which had been placed on top of the building.

q. Item: Drilling Concrete with A Pneumatic Star Drill.

Discussion: A problem arose when it became necessary to make a continious footer out of existing pedestal footers. The main problem was tying in the pedestal footers so they would in fact act as a continuous footer.

Observation: In order to provide some means of joining the pedestal footings, a star drill was used to drill holes in the footer. A second problem arose, however, because the pedestal footers were too close together to permit the use of a star drill. The problem was solved by shortening the star drill being careful not to clog up the hollow area in the bit. "V" notches were then cut in the pedestal footers.

r. Item: Working Hydraulic Fill Areas.

Discussion: Hydraulic fill is material that has been pumped from the bottom of a river to a higher location and then allowed to dry. The Dong Tam base camp is made of such material. One of the problems that developed when trying to work hydraulic fill was the amount of water retained by the fill material.

Observation: The problem was solved by blowing holes at certain locations to allow the water to drain off. Areas that were still wet had to be worked a little at a time allowing the material to dry out as it was worked.

s. Item: Placement of Large Timbers.

Discussion: During the construction of the hardened shells for the MUST hospital units at Dong Tam, the problem of placing 12" x 14" x 28' timbers for the top of the protective shell developed. The spacing of the units was such that a crane could not position the timber.

Observation: The problem was solved by first leaning the timbers against the building by use of a crane. Two ropes were then placed on each side of the building and tied to the post. The ropes were attached to the timbers. Three men pulled on each rope as two men with peavies eased the timber in place.

t. Item: Mortar Bunker Construction

Discussion: Throughout Vietnam, a variety of bunkers have been constructed for protection against mortar attacks. In order to build a good bunker in a minimum amount of time, some new innovations in the basic bunker design were made. Sand filled revetments were used instead of thousands of sandbags. The thickness of the revetment was left to the direction of the using unit. The overhead cover was made by placing a row of sandbags around the perimeter of the roof, placing sand over the rest of the roof, and putting some discarded airfield matting or roofing tin on top of the sand to act as a bursting layer. The bunkers were ventilated by covering the top two feet of the bunker wall with screen only. Allowing the roof to overhang from two to four feet provided protection for the exposed area at the top of the bunker. Twelve by twelve timbers were used for the basic framework, four inch lumber was used for the roof, and two inch material was used to cover the framework. Four 10' x 30' x 30' bunkers were found adequate for a 200 man company. The height should not exceed 11'3" since a front loader cannot fill revetments higher than 11'3".

Observation: Engineer units have the mission to build. They cannot afford to run back and forth between bunkers and sleeping quarters during mortar attacks. As more and more sleep is lost, construction effort is decreased. Incorporating mortar protection and sleeping quarters into one bunker keeps the personnel from losing sleep at night. The cost of materials is more than compensated for by the active construction time saved and because of the added protection against first round hits. Morale of the troops is also improved knowing they have the added protection afforded by the bunkers.

3. Training and Organization:

a. Item: New Personnel Orientation.

Discussion: All new personnel arriving in Vietnam should be given a detailed orientation lasting anywhere from three to five days. However, the time, personnel, and facilities needed for such an orientation are not available at the battalion level.

Observation: If at all possible, new personnel should receive an orientation from a group or higher level academy. Such academies have the necessary facilities and personnel to conduct a detailed orientation.

b. Item: Individual Training Records.

Discussion: Many new replacements arriving from the United States do not have their individual training records with them. Without a training record, it is almost impossible to determine what training the individual has or has not had.

Observation: Probably the only solution to the problem is to have the individual's former unit insure that the man has a training record and the training record is forwarded to the man's next duty station.

4. Intelligence: None

5. Logistics: None

6. Maintenance:

a. Item: Propshaft for Entrenching Machine

Discussion: The propshaft from the power take off to the differential that drives the chain bucket assembly on the entrenching machine is noted to be an item difficult to obtain through normal supply action.

Observation: The propshaft can be repaired by using a 2½ ton truck "U" joint which has had the bushings machined to fit the propshaft.

b. Item: Installation of jackshaft on 5 ton and 2½ ton trucks.

Discussion: When replacing a jackshaft, a common error is to place the jackshaft in backwards. A jackshaft installed backwards will vibrate excessively during operation causing the jackshaft bolts to loosen.

Observation: By keeping in mind one simple rule of thumb, proper installation can be arrived. The male spline on the jackshaft must be pointing toward the front of the vehicle.

c. Item. M151A1 Differential

Discussion: The mistake is often made of replacing a leaking differential when actually only a loose flange is causing the leakage.

Observation: Removal of the inner ring from the axle flange, coating it with permatex, and retightening the ring in the flange will often stop leakage and chatter.

d. Item: M151A1 Transmission Reverse Selector Arm Retaining Bolt.

Discussion: Frequently the reverse selector arm retaining bolt in the upper left side of the transmission has been mistakenly removed when the operator removed the transmission fill plug. When the bolt is removed, the selector arm falls inside the transmission and if not caught in time could cause extensive damage in the transmission.

Observation: Use of the lubrication order by the operator and close supervision by the supervisor will prevent removal of the reverse selector arm retaining bolt.

e. Item: Bucket Ram Hydraulic Lines, Scoop Loader H90CM.

Discussion: The bucket ram hydraulic lines have been difficult to obtain through normal supply channels.

Observation: A hydraulic line for a H90CM bucket loader can be fabricated from the larger of the two sizes of hydraulic lines that run from the 290M tractor to the scraper. At the bucket ram, the connecting end of the defective line can be connected to the end of the 290M line. The 290M line can then be cut at the required length.

f. Item: Removal of 290M Tractor Wheels.

Discussion: With a 290M wheel elevated 6 to 12 inches off the ground, a scoop loader bucket with the bottom edge of the bucket parallel to the ground will conveniently slide under the wheel. The top of the bucket will come to rest flush against the side of the wheel. A cable cut to the appropriate length with a hook at each end will secure the wheel to the bucket while the wheel is being removed from the tractor. The scoop loader can also be used to replace the wheel.

Observation: When available, a scoop loader is the safest, quickest, and easiest method for removing a wheel from a 290M tractor.

g. Item: Removal of Broken Rear Axle Shaft on Contact Trucks.

Discussion: Due to the heavy load the contact truck carries and the varied places it must go, the rear axle shaft, especially the short shaft, often breaks. In order to remove the shaft in the ordinary manner, the differential must first be removed. Organizational maintenance personnel, however, are not authorized to remove the differential. Therefore, valuable time is lost sending the truck to direct support maintenance for repairs.

Observation: It has been found that the shaft may be removed without removing the differential first. One end of a copper wire is first connected to the positive side of a battery and the other end is

connected to an electric welding rod, mild steel. By placing the welding rod on the broken piece of axle shaft, a welded bond will be formed between the shaft and the welding rod. The shaft can be easily removed by pulling on the welding rod. Care must be taken, however, to insure the welding rod is completely taped except for the end to avoid accidental contact with the axle housing. Contact with the axle housing will cause another weld and possibly ruin the housing.

Section 2 (Part II) Recommendations: None

James Dorman

JAMES DORMAN
LTC, CE
Commanding

Incl
as

Distribution:
2-CINCUSRPAC, ATTN: GPOD-DT, APO 96558 (Air Mail)
3-CG, USARV, ATTN: AVHGC-DST, APO 96307 (Mail)
5-CO, 34th Engr Gp (Const), APO 96[illegible] (Courier)

EGF-OP (13 May 68) 1st Ind
SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 30 April 1968

DA, HQ, 34th Engineer Group (Const), APO 96291, 22 May 1968

TO: ACSFOR-DA, Washington D.C. 20310

Commanding General, 20th Engr Bde, ATTN: AVBI-OS, APO 96491

1. The subject report submitted by the 93d Engr Bn has been reviewed by this HQ and is considered comprehensive and of value for documentation and review of the reporting unit's activities and experiences.

2. This HQ concurs with the submitted report with the following comments:

a. Ref para 5b, page 10: An effort is made to avert shortages of construction materials through periodic forecasts of requirements. This has alleviated the problem to some extent. However, unforeseen requirements continue to place a burden on the supply system.

b. Ref para 5c, page 10: The recommendation stated concerning Construction Materials - Special Handling (CM-SH) is in keeping with the intent of the program - procurement of unusual contruction materials.

c. Ref para 10a, page 11: Lumber given to support the Vietnamese civic action program was salvaged scrap lumber.

d. Observations stated in the below referenced "Observations, (Lessons Learned)" are considered applicable but minor. They are either normally found incorporated within an engineer battalion's SOP or are published army-wide policies.

Ref para 2d, page 14:
Ref para 2j, page 15:
Ref para 2l, page 16:
Ref para 2s, page 17:
Ref para 3b, page 18:
Ref para 6b, page 18:
Ref para 6d, page 19:

e. Observations stated in the below reference "Observations, (Lessons Learned)" are considered noteworthy to merit consideration for possible adoption army-wide. No additional amplification is required by this HQ as the observations are self explanatory and the resulting benefits obvious.

Ref para 2a, page 13:
Ref para 2b, page 13:
Ref para 2c, page 13:
Ref para 2i, page 15:

EGF-OP (13 May 68) 1st Ind 22 May 1968
SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 30 April 1968

Ref para 2k, page 15:
Ref para 2m, page 16:
Ref para 2o, page 16:
Ref para 2q, page 17:
Ref para 2r, page 17:
Ref para 6a, page 18:
Ref para 6c, page 18:
Ref para 6e, page 19:
Ref para 6f, page 19:

f. Ref para 2e, page 14: The "Observation" is not true as a blanket statement. Many factors must be evaluated in determining whether prefab or built in place construction is the most efficient method of building walls. Some of the factors are: what carpenter tools are available; is a prefab yard established in the immediate area; are standard dosigns used; will engineers, non-engineers or local labor do the construction?

g. Ref para 2f, page 14: The size of the bunker and equipment availability must be considered before determining whether to sand bag or revet. Revetments for small bunkers such as perimeter guard posts may not be practical for tactical troops to construct. Another factor in revetting large bunkers is a means for filling a revetment that may be as high as ten feet. Most tactical units do not have bucket loaders. The indicated concept of revetments is excellent when constructed by engineer units.

h. Ref para 2g, page 14: Experience factors developed from Group projects involving laying of M8A1 matting resulted in an average of a 35-40 foot section of in place matting being stretched to remove the slack from the joints.

i. Ref para 2h, page 14: Concur with the statement that some matting is difficult to properly fit together. However, do not concur with the recommendation to cut the male bayonet locking connector. Different manufactured panels can be connected together. It does take some additional manhours to make the connections. The disadvantage of cutting the bayonet locking connectors is that it increases the possibility that adjacent panels will unlock due to lateral movement of the panels.

j. Ref para 2n, page 16: Group units do not have the proper test equipment to evaluate whether or not applying heat to straighten a steel structural member is more damaging than straightening without heat.

k. Ref para 2t, page 17.1: Concur with the Observation. Should be considered for adaption in Vietnam where applicable.

EGF-OP (13 May 68) 1st Ind 22 May 1968
SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 30 April 1968

1. Ref para 3a, page 18: It is not considered practical for Group HQ to provide orientation for incoming personnel. Orientation should be given at battalion level in order to give replacements an adequate orientation based on local procedures, practices, conditions and SOPs. Group HQ does not have the necessary facilities and personnel to conduct a detailed orientation with its current organization.

m. Ref para 6g, page 19: Method described should only be used in an emergency.

FOR THE COMMANDER:

WILLIAM E. EMERY
Major, AGC
Adjutant

Copy furnished:
CO, 93d Engr Bn

AVBI-OS (13 May 68) 2nd Ind
SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 30 April 1968

DA, HEADQUARTERS, 20TH ENGINEER BRIGADE, APO 96491

TO: Commanding General, USARV, ATTN: AVHEN-MO, APO 96375

1. Submitted in accordance with USARV Reg 525-15 dated 13 June 1968.

2. This headquarters concurs with the ORLL submitted by the 93rd Engineer Battalion (Construction) with the following exceptions:

a. Section 2, part 1, para 6a, "Propshaft for Entrenching Machine": This is a field expedient only; the proper part should be obtained and installed as soon as possible.

b. Section 2, part 1, para 6g, "Removal of Broken Rear Axle Shaft on Contact Trucks": Nonconcur. It is acknowledged that this procedure could cause additional damages and is dangerous. Therefore, this method should not be used. Equipment should be repaired at the appropriate level of support maintenance.

FOR THE COMMANDER:

RICHARD E. TAYLOR
1LT, AGC
Assistant Adjutant

COPY FURNISHED:
CO, 34th Engineer Group, APO 96291
CO, 93rd Engineer Battalion, APO 96370

AVHGC-DST (13 May 68) 3d Ind CPT Arnold/dls/LBN 4485
SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 30 April 1968

HEADQUARTERS, US ARMY VIETNAM, APO San Francisco 96375 19 JUN 1968

TO: Commander in Chief, United States Army, Pacific, ATTN: GPOP-DT, APO 96558

1. This headquarters has reviewed the Operational Report-Lessons Learned for the quarterly period ending 30 April 1968 from Headquarters, 93d Engineer Battalion (Const).

2. Concur with report as submitted.

FOR THE COMMANDER:

John V. Getchell

JOHN V. GETCHELL
Captain, AGC
Assistant Adjutant General

Cy furn:
HQ 93d Engr Bn (Const)
HQ 20th Engr Bde

GPOP-DT (13 May 68) 4th Ind
SUBJECT: Operational Report of HQ, 93d Engr Bn (Const), for Period Ending 30 Apr 68, RCS CSFOR-65 (R1)

HQ, US Army, Pacific, APO San Francisco 96558 28 JUN 1968

TO: Assistant Chief of Staff for Force Development, Department of the Army, Washington, D.C. 20310

This headquarters has evaluated subject report and forwarding indorsements and concurs in the report as indorsed.

FOR THE COMMANDER IN CHIEF:

K. F. OSBOURN
MAJ. AGC
Asst AG

DEPARTMENT OF THE ARMY
HEADQUARTERS, 93D ENGINEER BATTALION (CONST)
APO San Francisco 96370

TRANSPHIBIAN TACTICAL TREE CRUSHER EVALUATION

SUPPLEMENTAL REPORT NO 2

I N D E X

* Withdrawn at DA Headquarters

I. INTRODUCTION

The LeTourneau transphibian tree crushers arrived in Vietnam on 27 July 1967, and have since been employed under varied conditions of terrain and vegetation. An initial evaluation report was prepared to cover the period of operation through 15 December 1967 and Supplemental Report No 1 was later compiled to cover the operational period 16 December to 24 December 1967. This report is intended to supplement the original report and to evaluate the performance of the transphibian tactical tree crushers for the period 1 January 1968 through 15 March 1968.

The Tree Crushing Detachment remains attached to the 93rd Engineer Battalion (Const) for tactical employment and further evaluation. The contents of this Supplemental Report No 2 reflect the observations, opinions, and engineering judgement of the commanders and staff officers most directly involved in the employment of the tree crushers. Continuous consultation was made throughout the period with the LeTourneau technical representative regarding the engineering feasibility of the planned and proposed modifications.

Special attention has been given to additional modifications, both required and suggested. Many points covered in the original report are more fully developed, such as disassembly, hill climbing ability, tree crushing capability and survival in a hostile environment. Comparative data on Rome plow employment has been included in the evaluation, to include operating unit cost and employment considerations.

II. PARAMETERS OF EVALUATION

a. Scope of Operation

1. Personnel and Equipment: The personnel and equipment of the Detachment remains essentially the same as that initially established under the 1st Logistical Command and later augmented by the 93d Engineer Battalion (Const). A total of 5 personnel were lost due to normal rotation and a total of 3 replacements were received during the reporting period, to bring the present detachment strength to 25 EM and one Officer (plus one civillian technical representative). Table I shows losses and gains by MOS.

Table I. MOS Losses and Gains.

Losses		Gains	
05B20	Senior Radio Operator	62B40	Engineer Equipment Repairman
63H20	Automotive Repairman	62E20	Construction Machine OP
76C20	Supply Specialist	62B30	Engineer Equipment Repairman
62B30	Engineer Equipment Repairman		
62F30	Crane Shovel Operator		

Recommended changes to the original proposed TDA are included in Annex A, to include changes recommended to enable the Detachment to operate on a Delta (Three Machine) concept. The Tree Crusher Detachment remained attached to Company A, The Engineer Equipment and Maintenance Company for this Battalion during the entire reporting period. One officer of the Battalion S-3 provided staff and inter-organizational coordination for logistics, security, and operational support.

2. Test Areas: Test areas were assigned during the reporting period based on both evaluation requirements and priority operational requirements. Due to the tactical situation, operational requirements dictated the majority of the utilization of the machine. A significant portion of the reporting period was spent in clearing defensive perimeters in support of units located in the Long Binh Area. No opportunity for full utilization of the tree crusher's capability to crush large trees was presented in the Long Binh area. Near the end of the evaluation period the crusher was utilized in the Binh Son area where single large trees and clusters of medium trees were available for evaluation purposes. A trace of all work areas is found in Annex B. During the reporting period, the Tree Crusher Detachment cleared a total of 1313 acres, operating in the following areas: Nhon Trach, Coordinates VIC YS 139817 (508 acres cleared), Long Binh, Coordinates VIC YT 075042 (657 acres cleared), and Binh Son, Coordinates VIC YT 211932 (148 acres cleared through 15 March 1968).

3. Equipment Hours: Total operational equipment hours for both crushers during the period 1 January 1968 to 10 March 1968 were 477 hours.

4. Maintenance Hours: Total maintenance hours, to include scheduled, unscheduled, and field modifications amounted to 2547 hours. a detailed breakdown of maintenance hours is contained in Annex C.

5. Instructional Hours: Total instructional hours during the reporting period amounted to 2103 hours, with all being devoted to operator OJT. No formal classroom training was presented during the reporting period.

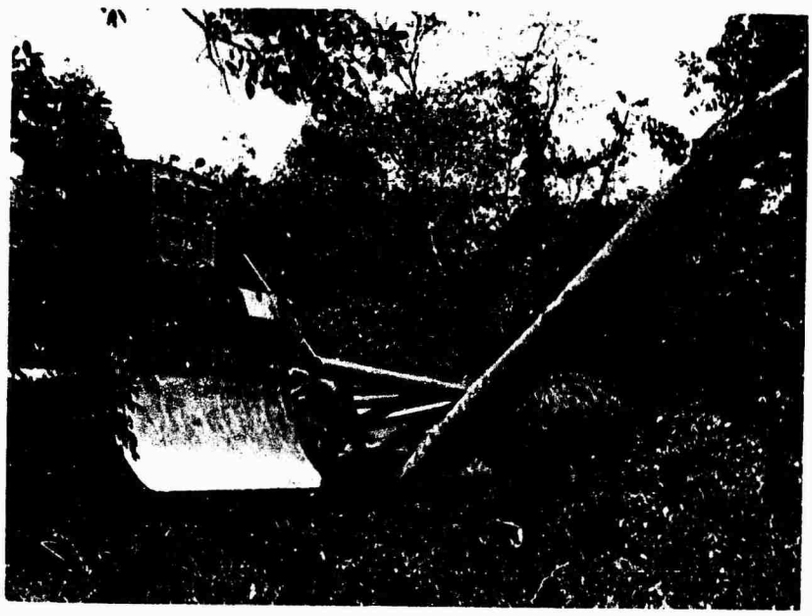
b. EVALUATION OF PERFORMANCE

1. Foliage Types vs Rates of Clearing:

(a) Heavy: Extremely heavy and dense foliage was encountered in both the Nhon Trach and Binh Son operational areas. The maximum size tree encountered was from 48 to 60 inches in diameter and from 100 to 150 feet in height (Photo No 1). The crusher exhibited no hesitation or difficulty in felling and crushing individual trees of this size (Photo series 2 - 5). The large root system of these trees when felled did not impede the forward progress of the machine. It was observed that the root clump for the largest trees felled was from 10 to 12 feet in height and the machine was capable of walking up and over such root systems, reducing the height to less than three feet (Photo No 6). Scattered groupings of comparable large trees were found in the Binh Son area. Groups containing 4 to 6 trees of diameter up to 48 inches were most commonly found (Photo 7 & 8). Such groups when collectively attacked presented a noticeable obstacle to the machine. This was felt as a distinct pull down on the DC generator and primary diesel engine. Forward motion was subsequently slowed but not stopped in any instance. When the tree group began to fall, the machine regained full forward motion and continued across the downed trees. The aggreated diameter of these tree groupings is estimated equivalent to a single tree of diameter 72 to 96 inches. The ability of the tree crusher to completely remove trees of this size in a single pass must be considered impressive and greatly superior to the capability of Rome plow or similiar equipment. It was observed that the trace left behind the crusher was easily traversed by the security M 113 APC's offering very little obstacle to their movement. Heavy concentrations of bamboo or other foliage presented a problem of visibility for the operator but did not physically impede the machine (Photo No 9). Thick bamboo foliage, when forced to the ground by the push bar, completely obscures the operator's view of the ground. The operator must slow the machine for safety reasons due to the decreased visibility. On one specific occasion during the reporting period, lost time resulted directly from the operator's inability to see a deep ravine because of the bamboo mat. The machine slid sideways into the ravine and lodged, requiring external extraction. In most locations encountered in Vietnam, the thickest growth of bamboo is found adjacent to ravines, which compounds this problem.

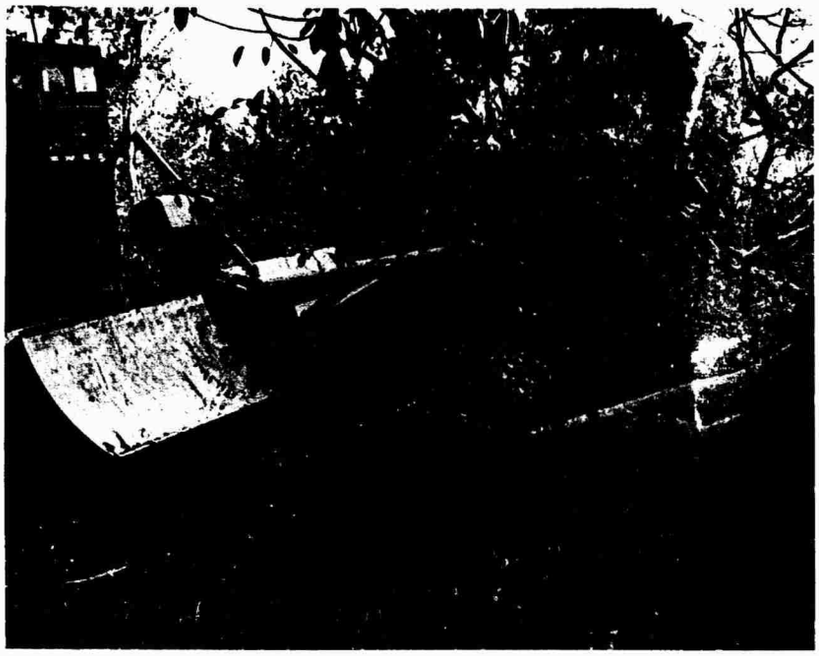
Photograph No 1 (Binh Son) Typical of largest trees encountered during evaluation period. 48 to 60 inches in diameter at base and 100 to 150 feet in height.

Photograph No 2 (Binh Son) Jungle crusher approaching single large tree. (Continued Series)



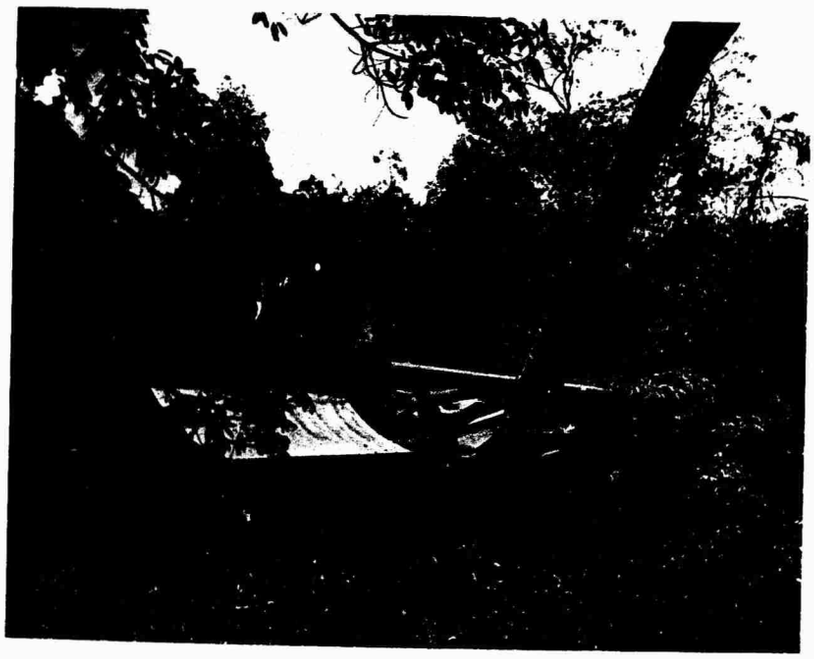
Photograph No 3 (Binh Son) Continued series showing Jungle Crusher felling large tree.

Photograph No 4 (Binh Son) Continued series



Photograph No 5 (Binh Son) Continued series showing felled tree.

Photograph No 6 (Binh Son) Jungle Crusher walking over root system of felled tree. Root clump reduced to height no greater than 3 feet.



Photograph No 7 (Binh Son) Tree grouping typical of those encountered in the Binh Son operational area.

Photograph No 8 (Binh Son) Jungle Crusher felling tree groupings in Binh Son operational area.

Photograph No 9 (Binh Son) Dense foliage presents problems of forward visibility to operator.

(b) Medium and Light: Medium and light foliage was encountered in the majority of the operational areas. Excellent results continued to be obtained using the amphibian drums during the entire period. The clearing rate averaged 2 to 4 acres per hour, depending to a large degree on the surface conditions. Slightly higher clearing rates were experienced in light foliage because of the increased operator visibility and much lower clearing rates were experienced in the wet areas containing many small streams. Use of the tree crusher in medium and light foliage does not allow full utilization of the machine's capability to destroy heavy and dense jungle. It is the opinion of the commanders that operational areas should be selected which will fully use the capability for which the machine was designed.

Observation of areas crushed during the previous three month evaluation period shows no significant regrowth of foliage. The actual rate of future regrowth must be evaluated further when the effects of monsoon can be seen. No significant regrowth was observed in those areas previously burned after crushing. Likewise, a complete evaluation of the value of burning must be delayed until after the monsoon season, at which time the areas should be compared for rate of regrowth.

2. Surface Conditions: It was noted that working in the same general area and in the same type of soil this reporting period and last reporting period, that the moisture content of the soil was significantly lower due to the dryness of the intervening months. It was also noted that with the lower moisture content, the soil was much more cohesive and presented greater resistance to the rotation of the drums. This fact was evident in that motor failure due to overload and overheating was greatly increased during this reporting period. The crushers exhibited a tendency to "burrow in" and settle into ustable soil areas. The unbroken curved configuration of the amphibian drums then acted like huge suction cups and created a resistance to rotation greater than the drive motors were able to overcome. A typical sample of this soil type was taken from the Long Binh area for testing. Test results (see figure 1) indicate the soil is a CH classification soil, with a plastic index (I) equal to 27.3. Photograph No 10 shows the depth to which the machine buried itself in this material. Use of the AVLB and Light Track Recovery Vehicle, in the arrangement shown in photograph No 10 was unsuccessful in extracting the machine. A single M88 VTR was later able to extract the machine working by itself.

The lower ball of the rear tug assembly contributed greatly to the resistance offered by the machine to extraction. Modification and redesign as suggested in the initial evaluation to both the rear tug assembly and the drums would have a definite advantage over the present configuration under these conditions. The 12 point split drum would decrease the suction effect on the soil and the higher tug assembly would not be buried to a depth sufficient to cause resistance to extraction.

Photograph No 10 (Long Binh) Tactical Tree Crusher partially buried due to unstable soil conditions. Attempted extraction by scheme shown here was unsuccessful. A single M88 VTR was later used to extract machine.

Clearing rates under various surface conditions as reported in the initial evaluation have proven to be valid except in areas containing many small streams as encountered in the Long Binh area. It was noted that terrain in which small meandering streams are found, as typical of the upper delta region of Vietnam, significantly reduce the clearing rate because of the inability of the machine to operate in a systematic straight path. Terrain of this type requires constant forward and reverse operation, laterally to the stream direction (see also par 3 below). In the Long Binh area, several dry rice paddy fields were crossed with the drum points penetrating no more than 12 inches into the soil. During the wet season the same area would be very difficult to cross, however the suggested modifications to the drum and rear tug assembly would be a distinct advantage over the present configuration.

3. Techniques of Using Equipment in Varied Terrain.

(a) Ravines: Ravines were encountered during this reporting period with side slopes up to 60 degrees. The machines were capable of climbing out of such slopes under their own power. In comparison with an APC, the tree crusher was able to climb slopes which could not be negotiated by the APCs. Experience shows that the limiting factor in climbing slopes is the inablility of the primary diesel engine to maintain positive oil pressure when inclined at an angle greater than 60 degrees. Except for short durations, the diesel engine cannot be operated at an angle in excess of 60 degrees without overheating. Clearance of the front bumper assembly and rear tug assembly is also a limiting factor. When the slope angle is greater than 60 degrees, the fromt bumper and rear tug will be driven into the ground when the machine begins to climb the slope. Technique used to climb steep slopes is to approach the slope at right angles with the bumper raised to its highest position. Approaching a steep slope from the side will result in the machine sliding down the slope along the line of the cutting edges of the drums. Just sufficient power is fed to the drive motors to maintain slow but steady forward motion. Attempts to increase the forward motion prior to entering the slope are not desireable, but rather, an even application of power is most successful. The degree of slope which the crusher will climb is inherently dependent upon the surface conditions and traction obtainable. Under ideal conditions (maximum traction) the machine can pull itself up and over vertical obstacles, within the limitations that the obstacle is no higher than the clearance from the lower part of the bumper to the ground (5 feet) or from the lower part of the main frame to the ground (5½ feet).

(b) Meandering Streams: Terrain containing numerous meandering streams was encountered in the Long Binh operational area. Two methods have been found to be most successful in clearing terrain of this type, depending on the height and soil conditions along the stream banks. The best method found to clear streams having steep and unstable banks is to cross and recross the streams laterally rather than try to follow the bank line. The danger of dropping one drum into the stream is everpresent when movement is along the stream and maneuver is difficult. By moving laterally across the stream, the crusher is better able to climb in and out of the stream and the trace of the stream is then easily identified. Normally an area 50 meters wide is cleared on each side of the stream and then normal clearing techniques are used. When clearing by this method, production is decreased to approximately 1.0 to 1.5 acres per hour.

A second technique should be used when bank conditions are stable and with gradually sloping banks no higher than 10 feet. The machine enters the stream and follows its course to the end of the work area, crushing as much as possible on each side of the stream. The machine then climbs out and makes a second pass along the bank, giving the operator the required visibility of the streams configuration. Production using this second technique is slightly greater than that obtained using the first technique.

4. Performance in Unsecured Areas: Adequate security and a dependable means of resupply remain essential to operations conducted in insecure areas. Crusher output during daylight hours is not affected provided a mobile security force of adequate size is available. It is essential that a portion of the security be mounted to maintain close contact with the machines during movement. Security mounted in APCs are able to follow close behind the tree crusher through dense jungle by following the crushed mat. Night security is approached from two concepts, depending on the location of the work area in relation to a secure base camp. One concept is to have the machines return each night to a secure area. No lost time results provided the route of movement to and from the secure area is included within the work area. This concept of night security was used when operating in the Nhon Trach area, the machines spending approximately two hours per day crushing a trace to and from the RTAVR base camp. The second concept provides for night parking outside a secure base camp, usually at the stopping point at the end of the days work. This concept usually results in lost time to allow daylight hours to prepare defensive positions. If sufficient security troops are available, a two shift security force should be used (day shift and night shift). Such an arrangement permits the crusher to work until dusk, arriving at a pre-planned defensive perimeter already established by the night security force.

5. Performance as Affected by Extended Operations: Extended operations were not evaluated during this period. In all operations under taken the machines were easily accessible at all times for maintenance, POL, and other support. Certain conclusions can be reached, however, which are applicable to extended operations. A reliable navigational system mounted on each machine is essential when operating long distances from base areas.

A recommended system would be an electric gyro-stabilized compass, shock mounted, in the cab of each machine. Additionally, during this reporting period, much down time was experience due to the inablility to extract machines which became stuck either because of soil conditions or motor failure. On extended operations, a single machine operating alone would be extremely difficult to extract from such a condition if located a long way from a base camp. On extended operations, it is essential to employ a minimum of two machines together to insure a ready means of towing a disabled machine. A Delta (three machine) detachment should be strongly considered to insure the capability of always employing at least two machines together. Providing a detachment with three machines would permit one machine to be pulled down for scheduled maintenance while the other two machines continue to work. Also, in the event one machine is deadlined for maintenance or parts over an extended period, the detachment can continue to operate with two machines.

c. Security and Control

1. Effect of Enemy Action: During this reporting period the tactical tree crushers received small arms fire and RPG rounds while operating in the Nhon Trach area. Crusher No 1 was hit with approximately 200 rounds of AK47 or equivalent rounds, sustaining only minor and easily repairable damage to the frame and cab structure. The bullet proof glass proved effective in stopping direct hits from the AK47. One RPG-2 round entered the left side of the power house just above the armor plate. The point of entry was on the wire cage which provides ventilation for the diesel engine. The round exited on the right side through the armor plate near the operator's cab. The entrance hole was approximately 14 inches in diameter and the exit hole was approximately 2 inches in diameter. Damage from the round was primarily due to shrapnel in the radiator, and main DC generator, and the engine exhaust system.

(a) Radiator: Fourteen pieces of shrapnel either lodged in or passed through the radiator. Water was added on site and the copper circulation pipes were pinched off at each damaged point. This temporary repair was sufficient to make the unit operational for return to a secure area. The radiator was later removed entirely and sealed using epoxy and silver solder.

(b) DC Generator: Pieces of molten shrapnel entered the DC generator through the air vents located just under the point of entrance of the RPG round. The hot shrapnel caused the banding around the generator armature to shred out of the vent holes. On site the banding and mica were removed from the armature and the vent cover replaced. With this temporary repair, the generator could be operated until the machine reached a secure area. The DC generator was later replaced completely.

(c) Exhaust System: Numerous small holes were burned or blown through the exhaust system. No repairs were made on site. Upon reaching a secure location, the system was dismantled and the damaged parts repaired by brazing.

2. Effect of Anti-Personnel Mines: Definite identification as to type of mines encountered cannot be made, however it is believed that the crusher detonated a type of VC anti-personnel mine on four seperate occasions in the Nhon Trach area. The effect of the mine was felt as a slight jar of the machine and a dull metal to metal sound. The drum was slightly scarred with a spherical indentation on the drum face. After running the crusher approximately 30 hours the indentation slowly stretched out leaving the original shape on the drum face.

3. Vulnerability to Anti-Tank Weapons: Actual experience with anti-tank weapons is limited to that reported above. However, it is recognized that the tactical tree crusher is extremely vulnerable to this type of enemy action and it deserves special mention. Because of its size and lack of maneuverability, the tree crusher cannot effectively evade an anti-tank weapon. The element is entirely dependent on the security force for protection. The point of maximum vulnerability is the power house and operator's cab structure. One well placed round will effectively immobilize the machine, leaving it further vulnerable to total destruction. Modification of the engine and cab enclosure to include a sloping armored profile (se fig 4) would provide some measure of protection. Use of an air cooled engine would preclude damage to a water cooled radiator system. (See paragraph II g. below)

4. Use of Mounted Claymore Mines: Claymore mines placed along the sides of the power house would provide very effective protection from direct assault by an enemy force on either flank. Mounting brackets and back up reinforcement would be the required modification. The firing device would be controlled by the operator from within the cab and would require an effective safety feature to preclude accidental firing. Claymore mines would be particularly valuable when cutting a single path trace through dense jungle when it would be impractical to maintain flank security forces.

5. Mounted Machine Gun: A machine gun cupola mounted on top of the operator's cab would provide additional firepower for the machine for flank security. Either a 7.62 or .50 caliber machine gun mounted in a movable circular mount and manned by the assistant operator would give 360 degree coverage.

d. Maintenance: Repair parts usage during the reporting period is detailed in Annex C. Repair parts continued to be supplied from on-hand stocks or through Philco-Ford in Saigon. Repair parts usage factors experienced this period are influenced by the special maintenance problems resulting from enemy action in the Nhon Trach area. Extensive electrical repairs and replacement of major components were required. With one exception, the PLL and ASL was adequate to keep the machines running throughout the period. Excessive burn out of drive motors resulted in one machine being deadlined for parts for the last 30 days of the evaluation period. Difficulty in requisitioning the required parts from CONUS due to lack of proper fund citations was experienced initially but has been corrected. A complete inventory of PLL and ASL on hand in the detachment and at Philco-Ford as of 15 March 1968 is included in Annex D.

e. Support

1. Additional Maintenance Support Required: In-country capability to rewind and rebuild the field and armature windings of the main DC generator and drive motors should be considered. This capability does not exist within the Detachment and should be provided by contract or at the depot support level. Such support activity would permit use of rebuilt motors and generators in-country as an alternative to ordering new assemblies from CONUS.

2. POL Support: Throughout the reporting period, POL was supplied by 2½ ton fuel tankers provided by the supporting unit. This system of resupply is entirely satisfactory and no problems were encountered in providing sufficient POL. On extended operations where fuel tankers could not reach the machines, resupply by air or fuel pod would be essential as discussed in the original evaluation.

3. Movement and Support Requirements:

(a) During this reporting period a complete overland movement of the detachment was made from the Nhon Trach area to the Long Binh area. All elements of the detachment were moved with the exception of the maintenance base which remains established at Camp Castle. To enable the maintenance base to become completly mobile an additional shop parts van, trailer mounted, a shop office, trailer mounted, and 3 each 2½ ton trucks for PLL and ASL would be required. Experience gained in the overland movement has shown that the loads can be arranged so as to move one complete machine on six each 25 ton lowbed trailers. Using this system of movement requires a minimum road and bridge classification of 36. Loads are arranged as follows:

LOAD NO	LOAD
1.	Powerhouse and Cab assembly
*2.	Main Frame with drivers attached
3.	Front Bumper Assembly
4.	Rear Drum
5.	Front Drums
6.	Rear Tug Assembly

* Critical Load = Class 36

Using this method, the drivers are not removed from the main frame, enabling the machine to be dissassembled and reassembled much more quickly.

(b) Disassembly and Reassembly: Disassembly was accomplished four times during the period. As the Detachment personnel became more familiar with disassembly, new and faster techniques were developed. Complete disassembly time averages only 12 hours with the use of a M88 VTR. Reassembly can be accomplished in 18 hours provided the VTR is available. Each disassembly and reassembly operation requires complete removal and subsequent replacement of the many drum attachment bolts. Experience has shown that due to the high torque which must be applied to these bolts, only two cycles of disassembly and reassembly can be expected before the bolts must all be replaced. The bolts have a tendency to strip and not hold the required torque after two cycles. No other special maintenance problems were noted as attributable directly to disassembly and reassembly.

f. Training: Formal training in both operation and maintenance of the crushers is considered a necessity due to the complex nature of the electrical and mechanical systems of the machine. Operators can be adequately trained to operate the machine through OJT, however, an understanding of the electrical system is just as important to the operator as to the maintenance personnel. The operator is solely responsible for controlling the power fed to the drive motors and must be able to recognize conditions of overload or critical power requirements in order to prevent damage to the crusher. Such knowledge can only be gained through formal classroom instruction.

g. Suggested Factory Modifications

1. Power and Control Moduals: Enclosing all electrical components within a single water tight modual, placed well above the water line and providing a convienient means of reaching electrical components for maintenance (figure 2). This modification would remove all critical switches, transformers, relays, and junction boxes from within the front axle and rear tug, thereby reducing the possibility of power failure due to water entering the axles. Three moduals would be required, one for each of the front drums and one for the rear drum. A definite maintenance advantage would be realized. It would be possible to assemble standby moduals for use in case trouble developed in a working module. Replacement of a single power and control module would eliminate the need for searching for damaged seperate components. The damaged module could be removed and replaced, allowing the machine to continue working while the damaged module was returned to a base maintenance area for repair.

2. Fixed 3-Position Bumper: The movable bumper assembly has proven to be of little value and is very seldom utilized by the operator. The movable bumper assembly was designed primarily for use with the rake attachment which was determined to be an unwanted attachment during the initial evaluation period. Removal of the AC lift motor, gear box, and rack would reduce the weight on the front axle and allow additional reinforcement of the bumper assembly itself. The proposed three position bumper (See figure 3) would permit adjustment of the bumper height for various types of vegetation, and still gain the advantage of simplicity and reinforcement of the bumper.

3. Power house and Operator Cab: Redesign of the basic configuration of the powerhouse and cab as shown in figure 4 would provide a lower silhouette and present a sloping surface which would minimize the effect of armor piercing rounds. These modifications would afford a greater passive defense against anti-tank weapons, in addition to reducing overall weight which would permit installation of heavier armor plate for protection of the operator.

4. Air-Cooled Power Plant: Converting from a water cooled power plant to an air cooled plant would eliminate the extremely vulnerable radiator system and preclude loss of the entire machine because of a cooling system failure. The air cooled system would permit the size and shape of the power house enclosure to be modified as discussed in paragraph 3 above. Forced air would be supplied to the engine by an air blower system, thus eliminating the need for the screened portion of the power house which is open to damage from small arms fire. Cool forced air could easily be tapped off the system to provide ventilation for the operator's cab.

5. Driver Seal: The driver oil seal should be redesigned as a double split seal, both to seal in the lubricating fluids and to seal out the water and dirt. The double seal should come in two sections, split so as to permit easy removal without having to remove the entire drum assembly. With the split double action seal, it would not be required to disassemble the entire driver assembly in order to replace a damaged seal. (See figure 5).

6. Rear Tug Junction Box: The present arrangement of the power and control linkage from the power house unit to the rear tug is a single 30ft length of cable. This cable is difficult to reach in many places for maintenance A suggested modification would be to provide a permanent encased linkage from the power house to a junction box located externally on the tug assembly, preferably near the steering motor. A second length of flexible cable would then be used to connect the junction box with the rear tug assembly. The flexible power cable would be partially exposed at all times and could be easily replaced in only a five foot section if damaged.

7. Power Control Warning Device: A power control device is suggested to give the operator in the cab warning when overload conditions are approached in the drive motors. This device could be in the form of a warning light, wired seperately into each drive motor to indicate overload. Such a device would give the operator sufficient warning when overheating of the drive motors occurs so that he can shut down the unit and allow it to cool before the motors become damaged. Devices are currently under development by LeTourneau which act to limit the amount of voltage routed to the drive motors. These devices are in the form of a solid state switching device which employ an adjustable governor set at a predetermined limiting value. This device must be environmentally compatible with the machine.

III. CONCLUSIONS

a. The conclusions reached in the initial evaluation remain valid.

b. Modifications suggested in the initial and supplemental evaluation as well as those additional modifications suggested in this evaluation could make the present configuration a better machine for employment in Vietnam.

c. The Detachment would be more versatile and better employed if it had three machines instead of two machines assigned.

d. The machines are an effective means of crushing traces through the thickest jungle and largest trees found in the testing area.

IV. RECOMMENDATIONS

a. Recommend that the Army does not purchase the two machines in their present configuration.

b. Recommend that the Army buy the present machines with all suggested and required modifications as determined by the evaluation period. Once the modifications have been made, recommend an additional 3 month evaluation period to determine the adequacy of all modifications.

c. Recommend that LeTourneau send an instructor to Vietnam to teach formal classes again, since the original personnel of the Detachment will have all departed on normal rotation by 1 July 1968.

d. Recommend that the acquisition of additional machines be strongly considered provided all modifications suggested during the evaluation period can be satisfactorily incorportated into the design.

e. Recommend that the final Detachment organization be provided with three machines instead of two machines as used during the evaluation period.

ATTERBERG LIMITS DETERMINATION

DATE: 12 FEB 68

PROJECT: TREE CRUSHER SITE

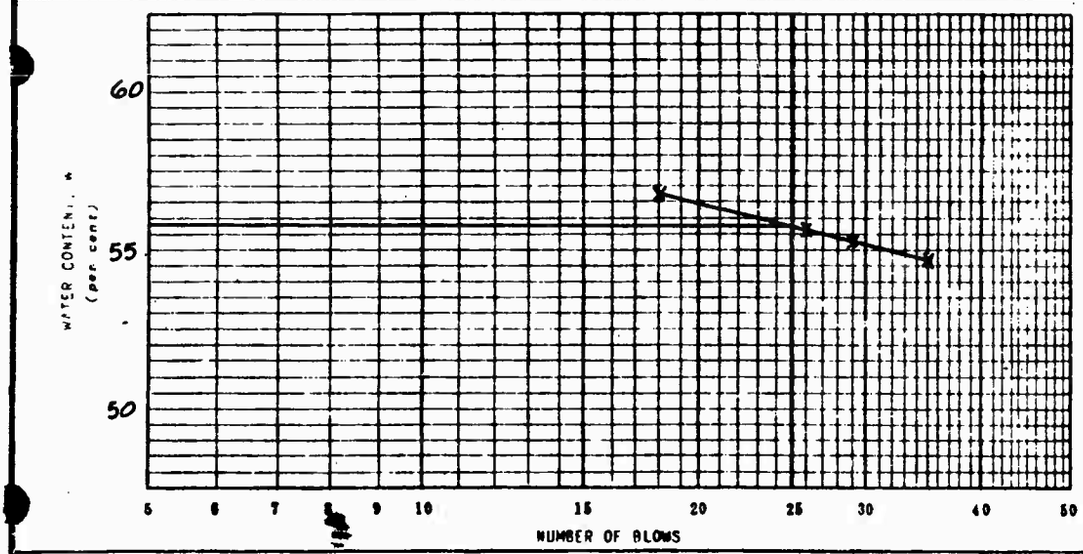
EXCAVATION NUMBER: 1

SAMPLE NUMBER: 1

LIQUID LIMIT, w_L

RUN NUMBER	1	2	3	4		
TARE NUMBER	15	17	20	19		
A. WEIGHT OF WET SOIL + TARE	22.8	23.4	22.7	24.0		
B. WEIGHT OF DRY SOIL + TARE	19.1	19.5	19.1	20.0		
C. WEIGHT OF WATER, W_w (A.-B.)	3.7	3.9	3.6	4.0		
D. WEIGHT OF TARE	12.6	12.5	12.6	12.7		
E. WEIGHT OF DRY SOIL, W_s (B.-D.)	6.5	7.0	6.5	7.3		
WATER CONTENT, $w=(\frac{W_w}{W_s} \times 100)$	56.9	55.7	55.3	54.7		
NUMBER OF BLOWS	18	26	29	35		

w_L 55.8 w_P 28.5 I_p (w_L-w_P) 27.3



PLASTIC LIMIT, w_P

RUN NUMBER		1	2		NATURAL WATER CONTENT
TARE NUMBER		23	21		
F. WEIGHT OF WET SOIL + TARE		17.9	18.7		
G. WEIGHT OF DRY SOIL + TARE		16.7	17.3		
H. WEIGHT OF WATER, W_w (F.-G.)		1.2	1.4		
I. WEIGHT OF TARE		12.5	12.4		
J. WEIGHT OF DRY SOIL, W_s (G.-I.)		4.2	4.9		
WATER CONTENT, $w=(\frac{W_w}{W_s} \times 100)$		28.5	28.5		
PLASTIC LIMIT, I_p (Average w)			28.5		

REMARKS

CLASSIFICATION = CH

TECHNICIAN (Signature): J S Nielsen

COMPUTED BY (Signature): J S Nielsen

CHECKED BY (Signature): Lindgren

DD, FORM AUG 67, 1209

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Figure 1 REPORT OF SOIL TEST FROM SAMPLE OBTAINED IN VIC. LONG BINH

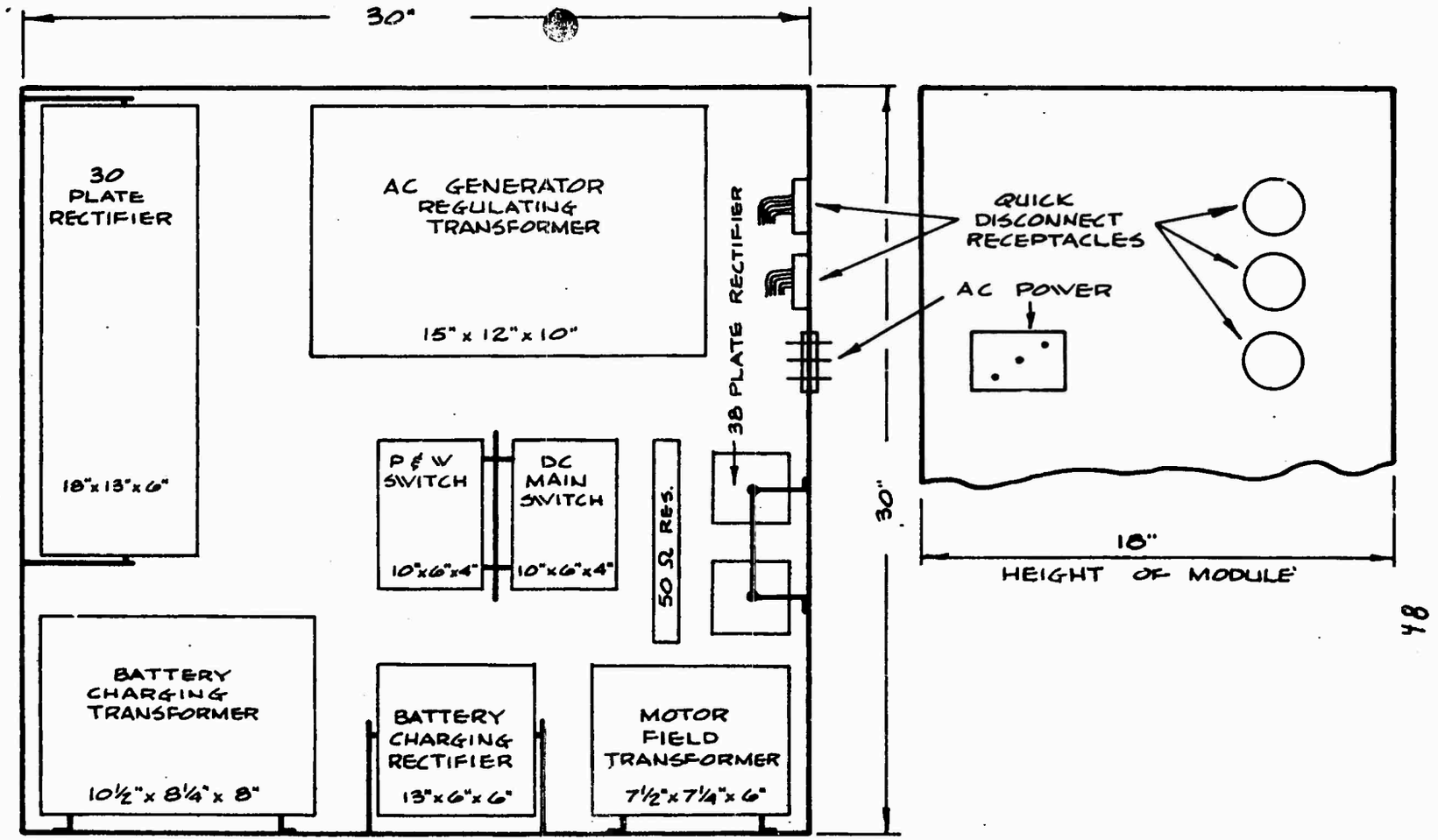

Figure 2

PROPOSED POWER AND CONTROL MODULE

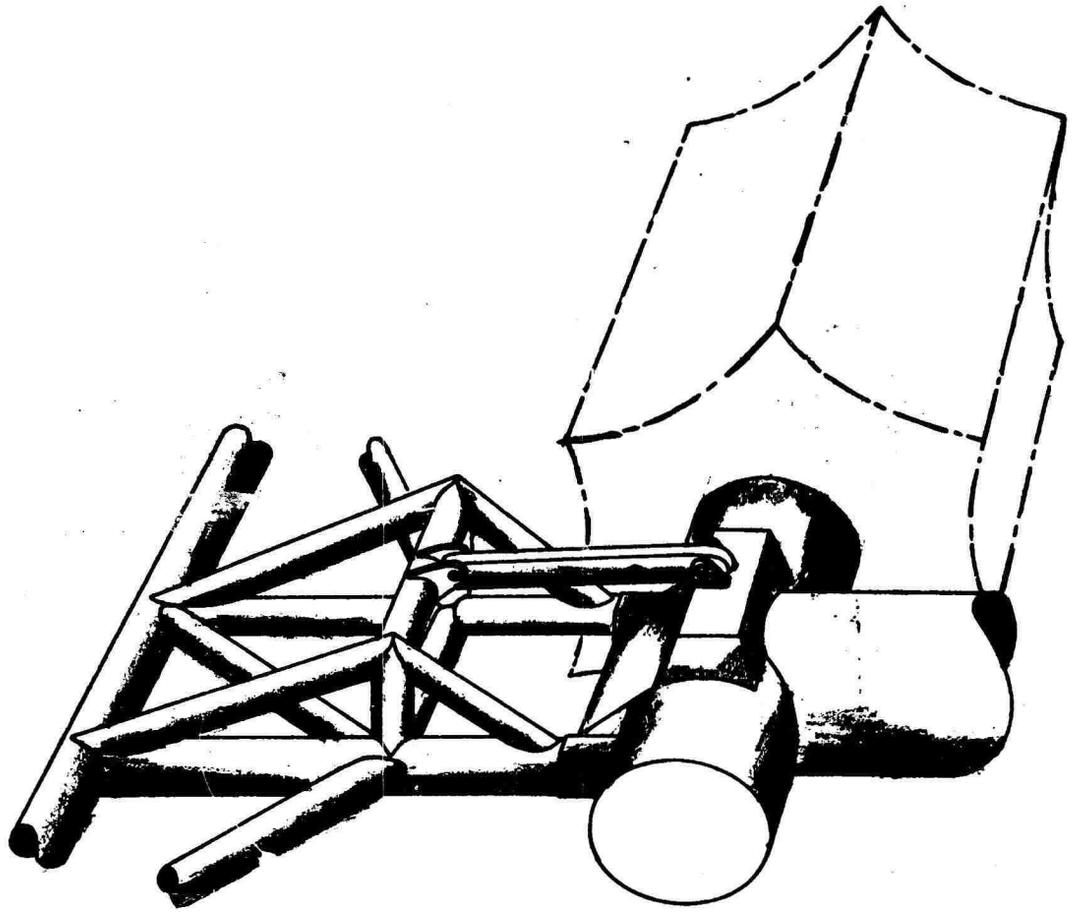

Figure 3

PROPOSED PUSH BEAM MODIFICATION

(Fixed 3 Position)

Ⓐ MODIFIED 3 POINT FIXED BUMPER
Ⓑ 12 POINT DRUMS
Ⓒ 50 CAL. MACHINE GUN
Ⓓ MODIFIED CAB
Ⓔ AIR COOLED ENGINE
Ⓕ CLAYMORE MINE MOUNTED
Ⓖ MODIFIED REAR TUG ASSEMBLY

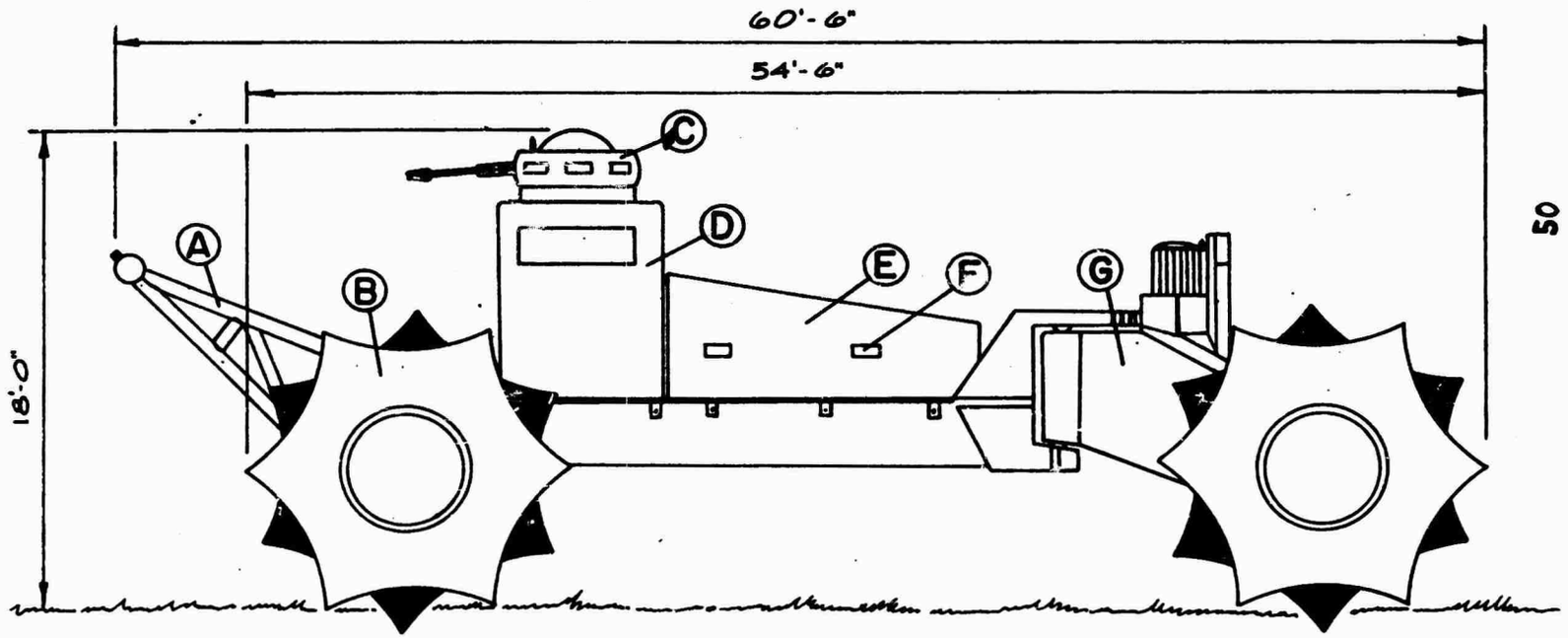

Figure 4
PROPOSED TREE CRUSHER MODIFICATIONS

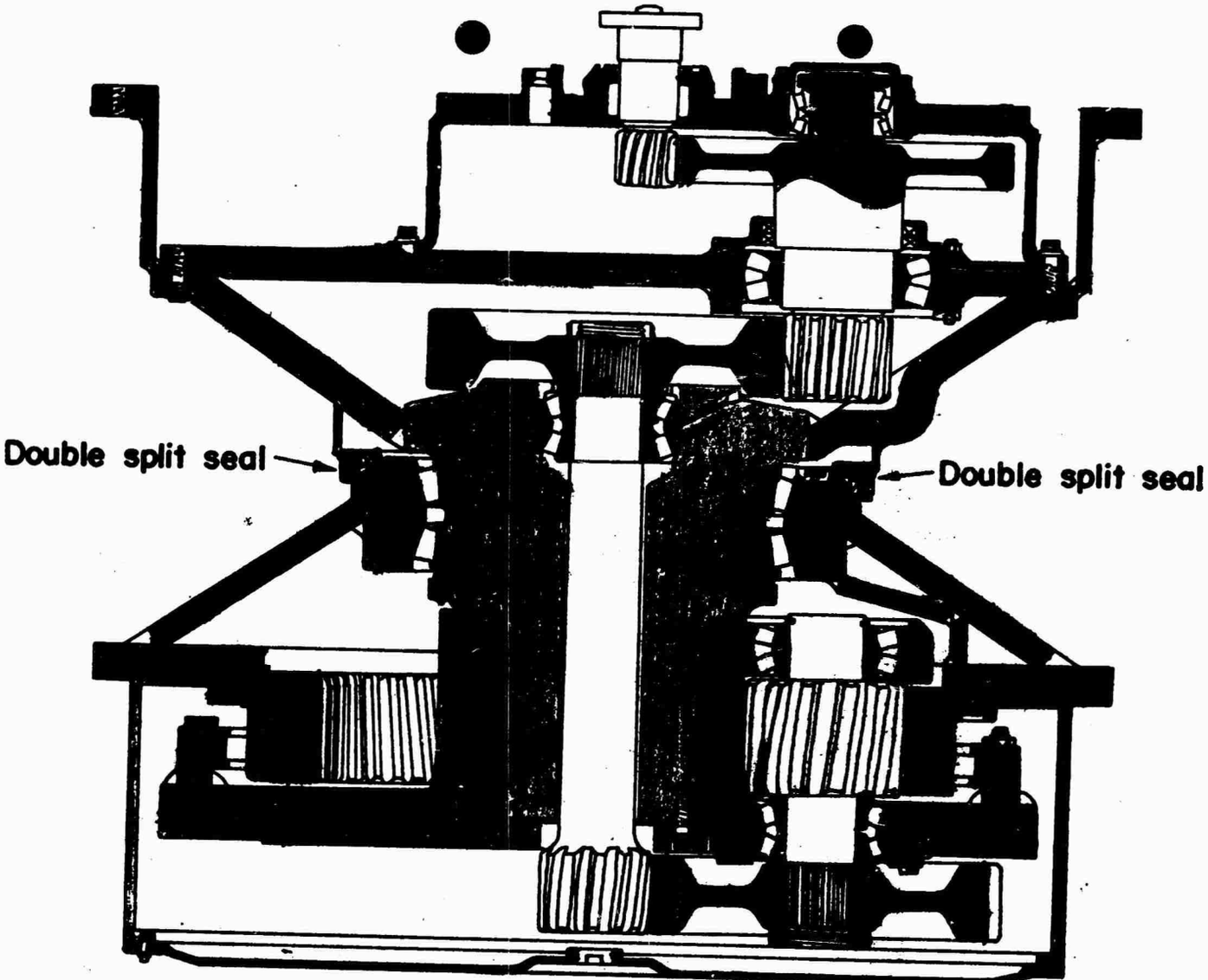

Figure 5 PROPOSED REDESIGN OF DRIVE ASSEMBLY

I. COMMENTS ON PROPOSED TDA

a. General. The TDA proposed in the original evaluation has proven to be adequate, supplying the minimum personnel and equipment required to perform the assigned mission. In general, it was felt the maintenance section was overstrength in personnel, being capable of maintaining three tree crushers more efficiently than the two machines now assigned to the detachment. Items of equipment contained in the proposed TDA which were not available (issued) to the detachment during the period where provided on an as required basis by the supporting unit. This presented no problem with the exception of those items discussed in paragraph I.b. below.

b. Effect of Non-availability of TDA Equipment.

The following listed items were not available or on hand by the Detachment during the reporting period. Items indicated by (#) were supplied on an as required basis by the supporting unit.

Para	Line	Description	Qty	Remarks
01	A72660	Antenna Group RC-292	1ea	#
01	E63317	Compass Magnetic Lensatic	1ea	#
01	J71304	Goggles Sun, Wind, Dust	4ea	#
01	V93888	Table, Folding Portable	2ea	#
01	V48921	Tent GP Med	5ea	#
01	Y34027	Watch Wrist	3ea	
02	B67081	Binoculars 6 x 30 Mil	2ea	
02	E62803	Compass, Gyro Miniature 115V 400 or 60 cy 70 watts mark 27	2ea	Required for extended operations. Not available
03	D11048	Carrier Cargo 6 ton M548	1ea	#
03	D80299	Chain Assy Sgl leg w/pear link	14ea	# also provided by supporting M88 and outside sorces.
03	NVAL	Tank Retriever, M88	1ea	Required. Obtained from outside sources
03	H19221	Floodlight set	1ea	#
03	L10505	Jack Hydr. Hand 100 Ton	2ea	#
03	V19950	Tanks Unit Liquid Disp	1ea	#

ANNEX A

Para	Line	Description	Qty	Remarks
03	V48441	Tent Frame Type Maint	1	#
03	W32456	Tool Kit Auto fuel & Elec	3	#
03	W67706	Torch Outfit cutting & Welding	1	#

The shortage of one M88 VTR affected operations of the Detachment in that much time was lost in recovery operations waiting for a VTR to arrive on site from another unit. Assembly operations were also slowed down due to non-availabi of the VTR. The shortage of the gyro-compasses did not affect operations this period, however if extended operations had been attempted, they would have become critical.

II. PROPOSED CHANGES

It is recommended that the future tree crusher detachments be provided with 3 Jungle Crusher Machines instead of the presently assigned two machines. The following changes are recommended in the TDA to accommodate 3 machines.

TABLE OF DISTRIBUTION AND ALLOWANCES

SECTION II ORGANIZATION

Par 01	Line 01	Det Cmdr	Change grade from LT to CPT
Justification:	The increased responsibility and operational potential of a three machine detachment is more commensurate with the grade of captain.		
Par 02	Line 02	Crusher Operator	Change Req from 4 to 6
Par 02	Line 03	Asst Crusher Operator	Change Req from 4 to 6
Justification:	To provide required number of operators and assistants for two shift operations of three machines.		
Par 02	Line E62803	Compass, Gyro Min 115V	Change Qty from 2ea to 3ea
Par 02	Line R94967	Rifle, 5.56 mm M-16	Change Qty from 9 to 1?
Par 02	Line	Transphibian Tacti l Jungle Crusher	Change Qty from 2 to 3

Justification: The Jungle Crushers should be employed with a minimium of two machines working together for efficiency of operations and insured capability to recover a downed crusher on extended operations. Scheduled maintenance and deadline of one crusher has made it necessary to operate with a single machine approximat 50 percent of the reporting period. Three jungle crushers assigned to a single detachment would increase the overall capability of the detachment plus reduce the amount of time it would be necessary to employ a single machine on operations.

ANNEX C

MAINTENANCE CONSIDERATIONS

1. Equipment hours (1 January 1968 - 15 March 1968)

   a. Total tree crusher hours: 477

   b. Total support equipment hours: 651

   Total 1128

2. POL consumption:

   a. Diesel (gal) 8,547 gal

   b. Oil (qts) 98 qts

   c. Grease (lbs) 120 lbs

   d. Approximate consumption in gal/hr/machine: 17.8 gal/hr

3. Total manhours (operations only): 2,103

4. Maintenance manhours total (Crushers) 3,354

   a. Preventive maintenance: 366

   b. Special problems and field modifications 2,988

5. Special problems.

a. Repair of Damage Caused by Enemy Action: At approximately 0945 hours, 17 January 1968, Jungle Crusher No 1 was hit by an RPG - 2 rocket. The round struck on the left side of the power house and exited on the right side just under the operator's cab. The round struck the throttle linkage and the engine dropped to idle speed immediately. This fact probably saved the main DC generator from more extensive damage because the generator shaft was slowed after the shrapnel cut into it. Temporary repairs were made on the spot sufficient to allow the machine to be driven out of the jungle under its own power. Once in a secure area, permanent repairs were made and the main DC generator was replaced completely. No special maintenance problems have arisen since which can be directly related to the damage sustained on 17 January.

b. Special Maintenance Problems as Related to Assembly and Disassembly:

Only one significant maintenance problem was noted which was a direct result of assembly and disassembly. Removal and assembly of the amphibian drums from the driver assemblies resulted in stripping of many of the 12 point mounting bolts. Extremely high torques are required for each bolt. In some cases the head of the bolts sheared off and the bolt holes had to be retapped. A maximum of two dissassembly and assembly operations could be expected before the bolts must be replaced with new bolts.

C. Burn Out of 4 Leaf Switch and W-Grid: Crusher No 1 experienced burn out of one 4 leaf switch and one W Grid. The cause was traced to loose primary generator leads at the generator housing. This was corrected immediately and no further problems were experienced.

d. Damage to Crusher No 2 Movable Bumper: On 15 February 1968, while moving into a night parking area, Crusher No 2's bumper hung on Crusher No 1's drum and snapped the bumper motor housing bolts and bent the housing frame. The entire motor, housing, and bumper lift rack was removed and the bumper assembly was welded in the raised position. The crusher was then operated with the fixed bumper without any difficulty.

c. Burn Out of Drive Motors: A high rate of burn out of drive motors was experienced this reporting period. On 17 February, Crusher No 1 burned out two rear drive motors. The probable cause of burn out was electrical overload to the rear drive motors when the rear drum became constricted due to poor soil conditions. With the rear drum constricted and the front drums relatively free wheeling, an overload was routed by the electrical circuit to the constricted drum . This problem is under study by the LeTourneau service engineer. A protective device on each drum to limit electrical power below a critical level has been suggested. A warning device in the operator's cab connected to heat sensing devices in each drum would also aid in preventing overload. On 22 February, crusher No 2 burned out the right front drive motors. The conditions of soil and overload were identical. There were not sufficient drive motors available in country to repair both crushers. Crusher No 1 was made operational by removing one good motor from No 2 and placing it in No 1. Crusher No 1 has not experienced any further problem of the nature to date. Crusher No 2 is still awaiting shipment of replacement drive motors from CONUS.

f. Rear Steering Rack: On 27 February 1968 Crusher No 1 slipped into a deep ravine that was an average of 45 feet across and 30 feet deep. As it slid into the ravine, the rear tug and drum were forced sideways to the left, causing the steering racks to be forced through the brake and limit switch. There is no known way to preclude this happening again. Both the limit switch and brake system will stop normal swing of the rear tug, however, in this case the full weight of the machine was on the tug. No damage was done to the machine. The rack was winched back into position (required movement was about 2½ feet) until the gears meshed and the machine was again operational.

g. Repair Parts Usage:

a. Preventive maintenance

(1) 9 ea fuel filters
(2) 4 ea air cleaners
(3) 1 ea fan belt
(4) 6 ea oil filters

b. Special maintenance

(1) 1 ea Exciter Generator
(2) 9 ea DC Drive Motor C-9
(3) 2 ea AC Field Reg Transformers
(4) 2 Ea Battery Charger Transformers
(5) 2 ea Motor Field Transformers
(6) 2 ea Battery Charger Rectifier
(7) 4 ea 38 Plate Rectifiers
(8) 1 ea 30 Plate Rectifier
(9) 2 ea Polarity Sensitive Switch
(10) 2 ea 7 leaf Switch
(11) 1 ea Blower Motor Assy
(12) 2 ea 4 leaf Switch
(13) 1 ea 3 leaf Switch
(14) 2 ea Power & Breaker Switch
(15) 2 ea 250 Linear Resistor
(16) 2 ea 145 Linear Resistor
(17) 2 ea DC Main Tacker
(18) 4 ea 50 mfd Capicators
(19) 8 ea 6 Plate W-Grid
(20) 2 ea 300 Linear Resistor
(21) 2 BK Assorted Terminal Lugs
(22) 2 ea 12 Plate W-Grid
(23) 8 ea Oil Seal (HR2871)
(24) 16 ea Roller Bearings
(25) 44 Ea Lock Screws
(26) 4 ea Bearing and Assy Spacer
(27) 4 ea Bearing Assy, Middle Pin
(28) 18 ea Capscrews
(29) 4 ea Oil Seals (JA8614)
(30) 4 ea Dust Seals
(31) 40 ea Capscrews
(32) 4 ea O-Ring
(33) 12 ea Bearing Spherical
(34) 250 ea Capscrew, Internal Ring Gear
(35) 12 Ea Bearing Assy, doubled
(36) 48 ea Capscrew, Cad Plate
(37) 12 ea Snaprings
(38) 144 ea Capscrews, Drum Cover
(39) 144 ea Copper Washer
(40) 8 ea Rubber Baffle Seal
(41) 144 ea Capscrew, 9/16" 2 thd flat head
(42) 200 ft O-Ring $\frac{1}{4}$ inch Mat'l
(43) 2 ea Rubber Baffle Ring
(44) 64 ea Capscrews 5/16" X $1\frac{1}{4}$"
(45) 64 ea 5/16" Nut
(46) 4 cans #1 Epoxy A & B
(47) 900 Wheel and Drum Capscrews

7. Summary: Repair parts usage increased during this reporting period. This increase is attributed to several reasons: (1) Repair of damage as a result of enemy action (2) Repairs made following the Nhon Trach experience 16 - 24 December 1967 (3) Routine replacement of parts resulting from disassembly and assembly operations. These maintenance problems are considered special in nature, although they can be expected to arise at any time during operations in Vietnam. Other than the special maintenance problems, few maintenance problems have been encountered as a result of normal usage of the machine. Virtually all maintenance problems were corrected by the military personnel of the detachment with technical supervision provided by the LeTourneau representative. As the maintenance personnel became more experienced and familiar with the machines they were able to perform special and routine maintenance with little or no supervision. Once the detachment personnel receive formal training in operation and maintenance of the crushers, it can be expected that the warrant officer as provided in the TDA will be able to supervise all maintenance functions satisfactorily.

ANNEX D PLL - ASL STATUS

The following is a complete inventory and PLL - ASL status as of the end of the evaluation period.

PRT#	NOMENCLATURE	STOCK CONTROL	REC	ASL	PLL	DUE OUT
NSN	Arm. Cord			0	1	1
" "	Asst. Term Lugs		2	0	1 3/4	0
" "	Cambri Tape		0	1	½roll	0
" "	Rubber Seal		0	0		4
" "	Shell darina #2		4	0		0
" "	#382 Let Simplex Cable		60'	0	60'	0
" "	Term. Lug Kit		0	2	13/4	0
" "	1# A & B Epoxy		4	2	2ea	0
" "	1# Spray Glyptol		4	0	1	0
100853	2 Cord. #10		50'	0	0	0
CS1053	Air Cleaner Element		8	18	2	0
HP1074	C/S		492	0	6	0
HL1111	Seal		0	1	0	0
JC1343	Point Term			2	4	0
HF1367	1 5/16 Socket		6	0	0	12
137423	Bearing		2	8	1	0
NSN	Elbow			2		0
NSN	¼" O Ring		400'	0		200'
1503536	#14 Mtr Lead			250'		0
HK1513	Gasket			9		0
SF1515	Bng. 101			1	0	0
C1520	Bng. 101			1	0	0
HS1585	5/16"NC Nut		64	0	40	0
R1601	Mtr Blower		1	1	1	0
HJ1607	Brg			2	0	0
HK1759	14 Post Term Strip (HG7070)		0	0	4	4
C177	Brushes		6	4	8	2* 4
J181	Brg.			1	1	0
J182	Coil			1	6	2
JB1889	Coil			2	6	2
JB1918	Glass			0	0	3*
JB1936	A A Driver 1 short(Hub)		1	0	1	0
CH1950	6-A-8 DC Gen Assy			1	1	0
CL2021	C/S		252	36	49	0
HF2055	Rad. Core		2	0	2	2
NSN	Res Linear 250m		2	0	1	0
NSN	Hose 2½ x 12½"			1	1	0
CF2132	" 2½ x 4"			1	1	0
HF2179	Liner		4	2	0	0
JB2251	Brushes Exciter Gen		0	20	0	0
JB2266	Gear		3	0	0	1
JB2267	C/S Gear		6	3	3	0
	C/S Pinion old			3		0

PRT#	NOMENCLATURE	STOCK CONTROL	REC	ASL	PLL	DUE OUT	
JA2408	Spid.er Assm. Inner		1	0	0	0	
CG2424	Brg			1	0		
HX2525	SW. POL		4	0	3	0	
JB2550	Spider Assy		1	0	0	0	
JB2552	Nut		2	3	0	0	
JB2580	Lid Structure			0	0	1*	
JB5281	Pinion C-9 Mtr		3	2	2	1	
HM2739	Brg.			1	0	0	
JB2802	Mtr. C-9		9	0	0	4	
HR2871	Oil Seal		12	3	4	0	
PS2936	Air Aircl. Elem. 100853			4		0	
HP2978	Point Support.			1	1	0	
HP2979	Point Support			1	1	0	
HP2983	Point			1	1	0	
HP2984	Point			1	1	0	
HP2988	Point			2	1	0	
HP2990	Point			2	1	0	
NSN - R3CX	Outer Piston Pack Gland Comp.		1	1		0	
" "	Inter " " " "		1	1		0	
JA3013	Brg. 127			1	0	0	
HO3049	Rectifer		2	1	2	0	
C315	Zerk Fitting			5	0	0	
NPN	O-Ring 3/16"		100'	100'		0	
HM3207	Brg			1	0	0	
HM3208	C/S		168	2	177	0	
NSN #33	Elec. Tape			1			
HM3302	Guage			1	1	0	
HV3349	W-Grid			2	1	0	
HP3370	Brushing			2	0	0	
NSN	3/4" Glass Tape			1		0	
NSN	Hose 3" x 4"			1		0	
HF3402	Lifter			2	0	0	
HO3402	" " "			4	0	0	
NSN	3/4" 12 Point 3/4" let dr deep		0	4*		0	
CD3426	W-Grid Plate		36	12	7	0	
NSN	3 # 4 & 4 Cond		50	50		0	
HP3459	Steel brk disc			36		0	
HP3460	Lined brk disc			28	11	0	
J3526	Gear Internal		5	0	0	0	
CH3701	C/S		24	0	2	0	
HH3763	Amp Meter		1	0		0	
HH3764	Shunt		1	0	0	0	
HV3799	W-Grid		20	0	0	0	
SG3840	Lock Screw		72	4	8	0	
HJ3862	Rectifier		5	0	2	1*	2
CM3978	Switch		2	1	2	2	
HF3993	Capacitor		3	3*	3	1	
NSN	#4 Locomotive Type Cable		30	0	10	0	
HO4007	C/S			20	0	0	

PRT#	NOMENCLATURE	STOCK CONTROL	REC	ASL	PLL	DUE OUT
HO4037	Coil			1	1	0
HV4142	Point & Magnet Assy		1	1	0	0
HV4151	C/S		36	0		0
HV4155	Mica Tube		2	0	0	0
CF42	C/S			6	0	
HK4234	Brush Spring L.H.		28	0	28	0
HK4235	Brush Spring R.H.		36	0	36	0
HS4342	Point Housing Assy		1	1	0	0
HS4347	" " "			2	0	0
HS4348	4 Leaf Point Assy			2	0	0
JD4352	7/8" 12 pt Socket sub.st		6	12	36	24
CY3693	Spindle Pilot		1	1		0
C43695	Clutch Dog		1	0		0
HO4500	DC Main		2	0	1	2
HK4512	Res. 145r		2	0	1	0
HW4513	Point			28	0	0
HO4532	Transf.		3	0	2	1
NSN	Hose 4" x 6"			1		
HO4630	Cont. SW.			4	2	0
HX4781	C/S		2	0	2	4
HH4913	Water Send Unit			1	1	0
HH4914	Oil Send Unit			1		1
JA4955	Blower Assy		2	2	0	
HS5105	Rotor			2	0	0
5109915	Gasket Set			4		0
511339	Spring			4		0
5111340	Rocker Arm			12		0
5111343	Rocker Arm			12		0
5111422	Brg			2		0
5111424	Washer			4		0
5111526	Pipe Assy			1		0
5111527	Pipe			2		0
5113953	Cyl. Liner			2		0
5114335	Seal			3		0
HE5115	Clamp			2		0
5115087	Cam followed			18		0
5115454	Seal			4		0
5116476	Seal			4		0
5117003	Bolt			8		0
5117005	Washer			8		0
5117016	Gasket			4		0
5117023	Bolt			8		0
5117269	Gasket			4		0
5117369	Connector			1		0
5117404	Gasket			1		0
5117629	Nut			4		0
5117962	Ring			2		0
5117976	Gasket			2		0
5117084	Brg			4		0
5119862	Thermostat			6		0
5121963	Gasket			2		0

PRT#	NOMENCLATURE	STOCK CONTROL	REC	ASL	PLL	DUE OUT
NSN	Hose 5½ x 4"			2	1	0
5124519	Ring O			2		0
5125108	Washer			4		0
5126327	Spring			1		0
5128640	Pushrod			27		0
5130959	Seal			2		0
5133767	Belt Set			1		0
5135756	Rod			2		0
5150013	Nut			2		0
5150193	Gasket			4		0
5150303	Retainer			6		0
5150322	Rocker Arm Shaft			4		0
5150325	Bracket			8		0
5150329	Gasket			4		0
5151601	Locknut			8		0
5152149	Brg. Cap			1		0
5152944	Gasket			4		0
5153284	Retainer			2		0
5153286	Screen			1		0
5154637	Ring			1		0
5169319	Shell Set			7		0
5172874	Nozzle			2		0
5175846	Gasket			1		0
5176228	Screw			2		0
5177764	Damper			1		0
5177773	Gasket			2		1
5177777	Valve			1		0
5179954	Rocker Arm			12		0
5184484	Insert			2		0
5186858	Spring			6		0
5188405	Retainer			2		0
5188406	Pin			1		0
5195167	Valve			32		0
5196026	Brg. Set			20		0
5196319	Shell Set			7		0
5196320	Rod Shell Set			48		0
5196375	Gasket Set			2		0
5196382	Gasket Set			4		0
5196383	Blower Repair Kit			2		0
5196386	Blower Kit			4		0
5196938	Fuel Pump Kit			4		0
5197933	Ring Set			2		0
5198465	Cyl. Kit			12		0
HF5227	Brg		2	2	0	0
5228765	Injector			24	0	0
5230007	Seal			4		0
J5267	Brushin 6-A-8		1	1	1	0
HF5318	Brg			2	0	0
HF5319				2	0	0
HH5415	Seal		8	2	5	0
NSN	9/16" Point Proto Socket			12*	12	0
4532	Dupl			0		

PRT#	NOMENCLATURE	STOCK CONTROL	REC	ASL	PLL	DUE OUT
5773014	Element Oil Filter			60	12	0
5574980	Element Fuel Filter			14	6	0
5575086	Gasket			2		0
5575087	Spring			1		0
HP559	Stator			1		0
HP5614	Exc. Gen		1	0	1	0
DC5636	SW			1	2	0
JA5658	Wh Mtr. Brg		20	2	2	4
JA5659	Snapring		2	0	2	0
JA5662	Seal Cage		2	0	2	0
JA5669	Snapring		2	0	0	
JA5673	Gen Brushes		108	72		0
CL6248	Duplicate					
HM5838	C/S			6	42	0
DF5869	Clamp			2	2	0
HO5928	Res. 300r		2	0	2	0
HK5992	Brush			16	16	0
HV6058	4 Leaf Switch		2	0	0	0
HV6059	Switch 7 Leaf		3	1	0	0
HO6110	Points		18	0	0	
CH6245	Gear			1	0	0
CL6248	Baffle ring		6	8	4	2*
CE6250	Copper Washer		144	18	128	0
HR6396	Switch			1	2	0
6436719	Element Fuel Filter			19		0
6437298	Gasket			8		0
HO6457	Starter			1	1	0
JC651	Blower 2 Stage			2	0	0
HV6725	Brg		8	0	5	0
HO6803	C/S			10	10	0
B685	V Belt		6	6		0
CD6826	6" Ball Seal			8	8	0
DF6898	Insulating Spacer		36	0		0
HW6920	Blower Mtr Assy		1	0		1
HO6940	C/S			4	0	0
HF6972	Amp Meter			1	1	0
HR7010	Armature 6-A08		1	0	0	0
HJ7013	Point			2	3	0
HR7036	Belt Fan			6		0
HR7037	" " "		6	6	9	0
HG7070	14 Post Term Strip		4	2	0	0
HF7166	Brake Kit			1	0	0
HO7210	Bolt Locker			8	0	0
HO7216	Transf. Batt Chg		2	2	2	0
HO7254	Housing Assy			4	0	0
HO7259	Housing Assy			6	0	0
HV7317	Brush Arm		12	0	0	0
HM7346	Bolt Block		24	6	4	0
HM7356	Pinion			1	0	0
HM7359	Pinion & Race Assy			1	0	0

PRT#	NOMENCL JRE	STOCK CONTROL	REC	ASL	PLL	DUE OUT
HX7399	Switch		2	1	1	0
JB7447	C/S Finion		12	0	0	0
JB7447-1	" "		12	0	0	0
CG7472	C/S			5	6	0
CG7474	C/S		2	0	1	4
CG7479	C/S		40	5	40	0
HJ752	Hose Clamp			2	1	0
CF7769	Gear			1	0	0
CF7782	Gear			1	0	0
HL7809	C/S			8	0	0
HL7920	Housing & Coil			1	1	0
HX7940	C-9 Arm		1	1	0	0
CF7945	Nylon Plug			2	3	0
CF7954	Oil Seal		1	1	1	0
CG7957	C/S			16	0	0
B81-S	Belt V.		4	8	6	0
8137404	Connecter			2		0
HB2656	Clutch Housing Gasket		1	1		0
CJ834	C/S		576	0	0	0
DG8379	Point			1	2	0
DG8380	" "			2	4	0
HX8381	Moving Point Assy			1	0	0
HY8381	Magnet Arm. Assy			1	2	0
HL8495	Zerk Fitting			2	0	0
8524267	Cooler			1		0
JA8614	Oil Seal		6	1	0	0
JA8616	Dust Seal		6	3	7	0
JA8618	Brg & Spacer Assy		5	0	0	0
H8620	C/S 5/16 x 1¼		64	0	64	0
CL8738	Spacer			1	0	0
CL8740	Oil Seal			1	0	0
HO8831	Magnet & Arm			1	1	0
HR8849	Motor Align Stud		4	0	4	0
HV8890	Lock Nut		6	1	0	0
HV8892	O'Ring		10	1	0	0
HP8908	C/S		48	0	84	84
HP8940	7/8" X 3/4" dr. std proto socket		4	6	6	2
JB8951	Snap Ring		45	0	18	0
JB8952	Roller Brg		39	0	13	0
HX8988	Brush Holder		4	0	0	0
HC902	Clamp			2	0	0
HO909	Contactor		1	1	1	0
JA9094	Salvage Ring			3	0	0
JA9097	Brg Assy double		17	0	14	2
HO911	Contactor DC Main		2	0	1	0
NSN	9/16" 12 Point ½" dr Soc.			12		12
HM9278	C/S		24	226	100	226
CF9361	Gear			1	0	0
HF9375	Nut			2	1	0
CJ9412	C/S		400	0	150	0
HL9457	Coil			1	0	0

PRT#	NOMENCLATURE	STOCK CONTROL	REC	ASL	PLL	DUE OUT
HR9474	C/S			2	2	0
C94834	Driver Roller Spring		3	3		0
C95021	Clutch Housing Gasket		1	1		0
C95022	Handle Gasket		1	1		0
C95027	Anvil Bushing		1	1		0
C95033	Anvil Shank		1	1		0
JA9643	Pin Retainer Plate		1	0	0	0
HH9739	Amature		1	0	0	0
HM9744	Brake & Power SW		3	1	3	0
JC977	Rubber Hole Plug		32	0		0
HG979	Hose			2	0	0
HR9823	Dust Shield		1	1	1	1
HY9828	Tap 9/16 25¢		4	0	4	0
JA9855	Rack Hinge Pin		1	0	0	0
SD9869	Roller Brg		6	6	0	0
S9878	Brg			1		0
HO9879	Rectifier		2	0	1	1
HV9904	Term. Strip		24	0	22	0
HV9905	" " "			4	0	0
HV9925	Transf		2	2	2	2
HL4557	3000 120 cps Coil				1	
HR1759	Brush A.C. Gen			0	3	
JB7447	C/S Pinion			-	3	
59878	Brg			1	1	
HR6355	Nut				2	
HV3791	W-Grid Assy 6 Plt.				4	
HS7166	Brake Res.				1	
HM9278	Capscrews				251	
J5267	Brush Ring Assy Less Brushes				1	
NSN	Hose 3½ 4½				2	
" "	Hose 2½ x 12				1	
" "	Hose .3 x 4"				1	
" "	Hose 2½ x 4				1	
H)979	Hose, Grease				6	
HE5115	Clamp				2	
HJ752	Clamp				2	
HR9818	Nut				1	
CM9878	Switch				2	
L52499-s	Gasket kit, Eng O.H.				2	
	1 5/16 2st Tap				1	
HW5148	Fan (Blower SN)				1	
	Countershaft Gears				3	
BP58	Belts				6	
HH734	Spacer				23	
	O-Ring ¼"				6	
CJ9412	C/S 15/16 x 2¼ Tapwhd 2st				2	
TP624	Filter Fuel				6	

ANNEX E

ROME PLOW DATA

I. Comparison of Employment Limitations

a. Size of Trees

(1) Rome Plow: The Rome plow can successfully cut trees ranging from 2 to 6 feet in diameter at the base. Operational experience has shown that there is a maximum size tree which may be cut, beyond which size the time required to cut the tree makes it more economical to remove the tree by demolitions. The maximum size tree the Rome plow is capable of cutting will vary with conditions of terrain and density of undergrowth. If the undergrowth is light and tree density is low, the greater the diameter tree the plow can cut efficiently.

(2) Tree Crusher: The tree crusher is capable of crushing trees of comparable size (2 to 6 feet in diameter). Although trees of this size were not encountered during the evaluation period (maximum size tree encountered was approximately 4 to 4½ feet in diameter), the ease with which the tree crusher removed trees of smaller diameter indicates the potential capability to remove trees up to 6 feet in diameter. Thickness of jungle undergrowth has relatively little effect on the tree crusher's capability to remove large trees. The tree crusher's bumper assembly overides undergrowth and the approach to the large tree is not impeded. Tree density does affect the crushers capability, reducing efficiency in proportion to the density of trees. The fact that the tree crusher is capable of removing large trees in a single pass, whereas the Rome plow requires several passes, is the basic advantage and efficiency factor.

b. Ground Conditions

(1) Rome Plows: The trafficability of Rome plows on high and dry ground far exceeds that of low and wet ground. Maximum acreage worked and maximum efficiency of operation can be obtained on high and stable ground. Undergrowth and tree density become less a factor of efficiency under conditions of good trafficability. In low and wet ground the factors of undergrowth and tree density can be ignored due to the fact that more than 50 percent of operating time will be spent extracting the plows from wet areas.

(2) Tree Crushers: The tree crushers operate most efficiently on dry, stable soil just as the Rome plows, however the tree crusher has a much greater capability of operating without difficulty in wet,

swampy terrain. In side by side comparison in the Binh Son operational area, the tree crushers proved superior in trafficability over wet areas. Both in crossing small streams and boggy areas, the tree crusher was able to move with little difficulty over areas which could not be traversed by Rome plows.

c. Safety

(1) Rome Plow: The operation of tractors, both Bull or plow type, carries with it certain hazards inherent to the equipment. The one particular danger involved in Rome plow operation is that presented by falling trees. The majority of these trees are between 70 and 120 feet tall and range from 2 to 6 feet in diameter at the base. When these trees fall after being cut, the tremendous weight of the tree is combined with the acceleration due to gravity and presents a formidable momentum upon impact with the ground or the Rome plow. Due to this ever present hazard it is not recommended for plows to work closer than 40 meters to each other.

(2) Tree Crusher: The hazard from falling trees is negligible with the tree crusher. The crusher pushes each tree forward in its path with very little backlash to the rear or sides. The complete protection offered by the operator's cab eliminates any danger of injury to the operator. Normal employment of two crushers together with one crushing an adjacent path slightly to the rear of the lead crusher results in a 64 foot swath in a single pass.

II. Comparison of Unit Operating Costs

The following cost comparison is based on information obtained from the 86th Engineer Battalion (C) (A) and on operational cost data extracted from utilization of the tree crushers during the evaluation period. Cost of repair parts for the tree crushers is based on 2500 hour (1 year) estimates made by LeTourneau.

	Estimated Cost of Repair Parts per Detachment Hour	Estimated POL Cost per Det Hour	Estimated Cost per Acre per Detachment (Fuel + Parts)	Maint Man-Hours per Detachment Operational Hour
Tree Crushers	$12.00	$2.50	$2.14	3.46
Rome Plows	$ 5.10	$15.40	$6.91	1.10

OBSERVATIONS BY THE LETOURNEAU SERVICE ENGINEER

A. Recommended Modification of present crusher:

1. The need for a modified main frame as proposed by LeTourneau's design engineers is more evident for operating during the dry season than it was in the wet season. The present structure of the lower pintle sometimes causes high centering while working areas traversed by ravines and creek banks, as well as contributing to sticking the crusher in wet areas by catching on obstructic such as logs and stumps or digging into heavy clay.

2. It is impossible to successfully modify the present type structure, therefore it is recommended this unit be replaced with one designed for use with the modified main frame. The design recommended by our engineers would afford much better ground clearance and tend to clear or ride over obstructions that block the present tug unit. It will have a planning effect in thick mud where the present design has a doging action. In thin mud or water the new unit will still have a rudder action for fishtailing and swinning.

3. This modification and change would improve performance of the crusher in all operating areas, especially where working the swamps during the dry season with little or no water present. And in event the crusher should become stuck much less assistance would be required getting free.

4. Recent operations on firm to rocky soil during the dry season confirms desirability of a universal 12 point split drum as earlier recommended by the service engineers, who were here during the first six months of operation. The kinetic shock on the components and overall structure resulting from the six point star drum running on firm to hard ground is causing an increase incident of loosening capscrews and in a couple of cases one or two screws have broken.

5. Remove the power unit from the present pushbar structure and modify for a three position fixed pushbar.

6. Consider the use of quick detachable power and control modules (3) to be mounted in front and rear of the power house section containing transformers and power regulating components in one and control switches and W-grids in the other two. This would enable personnel to quickly trouble shoot and isolate a malfunctioning component, and in event of a component failure reduce the down time tremendously.

B. Support equipment: Adequate support equipment should be maintained and availabl to the crushers.

1. Cranes have limited capabilities for use around the crushers, but in the hand of a good crew the VTR Mike 88 handles the tree crusher like it was designed for the purpose, and should the Army consider a crusher built along the lines of the proposed new design the Mike 88 would be very hard to beat.

2. An enclosed service and parts trailer stocked with parts, supplies and tools commonly used for routine maintenance which could be towed to the operating base camp would save much time in case of break down and at regular maintenance periods.

ANNEX F

C. Training Program: All officers and NCO's directly connected with the tree crushers should attend the LeTourneau Service Training School. They in turn should give on the job training to operators and mechanics.

NOTE: Experience during this dry period has indicated that extreme overload conditions sometime occur on one or another of the three pair of drive motors when the crusher bogs down or becomes stuck, especially with the present tug unit sunk in thick mud. The electrical system will stand these overloads for short intervals with pauses for cooling and suffer no damage provided the motors or generators are not worked long enough at a time under these conditions to cause overheating. Therefore it is recommended that consideration be given to the incorporation of a load limiting and/or temperature sensing stystem on the motors and generators.

NOTE: Some weight reductions would be acheived thru the proposed modifications to the present machines, and considerable more weight would probably be eliminated in a crusher such as proposed by the officers making the evaluation report. With regards to air cooled diesel engines or other speciality features, gun turrents etc. I can only quote Mr. Lee Jorgenson, Vice Pres and Contracting Officer for LeTourneau: We are quite flexible and would evaluate and attempt to furnish the Army anything they desire in line and compatible with our system.

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